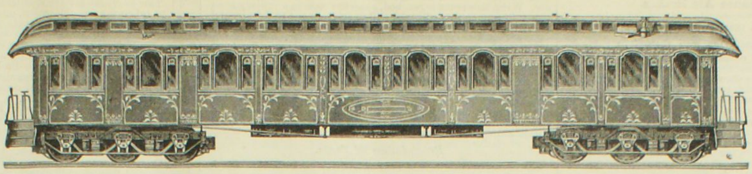
NATIONAL CAR AND LOCOMOTIVE BUILDER.



VOLUME XVIII. NUMBER 8. | AUGUST, 1887. | SINGLE NUMBERS, TEN CENTS, $1.00 PER ANNUM.

Miscellaneous Items.

The Atchison, Topeka & Santa Fe road has contracted with the Indianapolis Car Works for the construction of 1,800 box cars to be equipped with the Wagner car door.

The consolidated elevated railroad companies of Brooklyn have contracted with the Rhode Island Locomotive Works for 45 new engines, and with the Gilbert Car Manufacturing Co. for 150 cars.

Pennock Bros., of Minerva, O., have been awarded the contract to build 1,200 cars for the Cleveland & Canton road, which is soon to be changed to standard gauge. The box cars will have the Wagner car door.

The Michigan Car Co. has received contracts for building 500 box, 300 flat and 100 stock cars for the Ohio & Mississippi road. The cars are to be delivered after September 1 at the rate of 25 a day.

During the month of May the expenses for locomotives running on the Western & Atlantic Railroad were 1.88 cents per mile for repairs, 3.73 for fuel, 5.78 for wages, .85 for other expenses, a total of 12.24 cents per mile run.

The annual reports of the Master Mechanics' Association contain interesting reading and valuable mechanical information, which all railroad men ought to be familiar with. The reports can be obtained from the secretary or from this office for $1.50 each.

The greater portion of the Baltimore & Ohio Railroad passenger cars are now equipped with the Westinghouse automatic air brake. An order was given to apply this brake to the whole of the passenger cars, shortly after the Tiffin accident, and it has been carried into effect very promptly.

Coal for locomotive purposes costs the Old Colony Railroad $3.65 per ton of 2,000 pounds. This makes strong inducement to keep the average fuel consumption as low as possible, and it is well kept down. The whole of the engines belonging to the road averaged 44.60 miles to the ton of coal. This is remarkably good work, for the road is so badly broken up with branches and short divisions that it is impracticable to make the monthly mileage for each engine more than 2,400 miles.

The chemical laboratories connected with our leading railroads are devoting close attention to the character of lubricating oils and the quality of these oils offered to railroads having laboratories is improving. A first class lubricating oil should stand exposure to a temperature of boiling water for six hours without showing any appreciable loss from evaporation; its flashing point should not be below 300 degrees and it should not congeal at zero. For cylinder oil the flashing point should not be less than 500 degrees.

During a recent visit to the laboratory connected with the Chicago, Milwaukee & St. Paul Railroad shops, at West Milwaukee, we were very much interested in experiments that the chemist was making to try to burn pieces of wood that had been painted with Russell fire-proof paint. He held the wood in all sorts of positions over an intensely hot argand burner, and subjected it to heat of a very hot stove, but nothing could coax the wood to burn with flame. It would smolder away slowly, but it appeared to have lost the power of maintaining combustion unaided by other sources of heat.

By the monthly performance sheet summary issued by the mechanical department of the Cleveland, Columbus, Cincinnati & Indianapolis we note that 789 miles of road was operated during the month of May. They have 227 locomotives belonging to the road and 218 made mileage, the average running per engine having been 3,051 miles. The mileage to the pint of oil was 23.22 and to the ton of coal 34.49 miles. Repairs cost 3.64, oil and waste .26, coal and wood 3.47, engineers and firemen's wages 5.69, dispatchers and wipers .26, water supply .48, other motive power accounts 1.29, a total of 15.09 cents per mile, which is a good record.

An order has been issued reducing the working force in the Baltimore & Ohio shops at Newark, O., 25 per cent., and for placing the remainder of the force on short time. There is said to be enough work on hand to keep double the old force busy, and that a great part of the machinery is in miserably bad condition. But the necessities of stock manipulation require that the pay rolls shall be made exceptionally small at this time, and no one with the power to change a heartless policy cares for Baltimore & Ohio workmen being thrown out of employment.

Superintendent Lawler, of the Philadelphia & Reading, has issued a notice to all employés of the Schuylkill division that they must abstain from intoxicants whether on duty or not. Any man reported to him as having been seen taking a drink of liquor or beer will be summarily dismissed from the service of the company. He says in his order that "there is no business that needs levelheaded men more than railroading, both for the safety of the employés and the traveling public." All of which is right and proper, but we would like to see the officers of railroads give a better personal example on this matter than many of them do.

A lamentable accident happened to an engine that was pulling a special train with President Cleveland over the Rome, Watertown & Ogdensburg Railroad, two weeks ago that caused the death of the engineer. The train was making unusually high speed for that road, and while running about 60 miles an hour the right hand side rod of the engine broke, smashing the side of the cab badly and knocking off a blow-off cock at the side of the fire-box, which let the hot water and steam escape. The engineer lost his presence of mind and jumped or fell off through the gangway, engineer and was picked up dead. The usual gush was published about the man's heroism who whistled for brakes, then applied the air brake when the rod was dashing the cab to pieces, but failed to shut off the steam.

Mr. John Player, master mechanic of the Central Iowa, who is making for himself an enviable reputation as an inventor and a very successful railroad master mechanic, has worked out the details of a compound locomotive which appears to possess the requirements of a successful machine. The 17 by 24 cylinders of an ordinary locomotive are utilized as the low pressure cylinders and the high pressure cylinders are placed in front, tandem from the connections between the high and low pressure cylinders being similar to the arrangement of the steam and air cylinder or a Westinghouse pump. Both valves on each side are worked from the same rocker arm, and means are provided for admitting wire-drawn live steam into the low pressure cylinder as an aid in starting.

The Hanscom and Steel-McInnes Brakes.

Editors National Car and Locomotive Builder:

Will you permit me through the columns of your paper to reply to the statements made in the June number in reference to my brake? You say that "those well acquainted with the development of power brakes could recognize in the Hanscom brake a close relationship to the Steel-McInnes brake," the brake has two lines of brake pipe, "one connecting with the front end and the other with the back end of the cylinder. Pressure in one pipe applies the brake while the other releases." It seems that you must have been misinformed as to the construction and operation of the Steel-McInnes brake.

A comparison of the principal elements and the action of the two brakes will show that there is no close relationship between them, not nearly the relationship that there is between the Steel-McInnes and the Westinghouse, and no more relationship than there is between mine and the Westinghouse brake.

The Steel-McInnes brake has for its principal elements an air compressor, a main reservoir, one line of train pipe and a brake cylinder having an air reservoir at one end.

My brake has an air compressor, but no main reservoir, two lines of train pipes and a brake cylinder having one end extended, so that it serves as a reservoir *only* when the brake is applied by the train breaking in two.

In operation, the only relationship between the two is when my brake is applied as in the case above mentioned.

In my brake there is always an open communication between the brake cylinder and air compressor when the brake is applied by the engineer, and while this communication is open, the pressure on the brake beams may be reduced, increased, or graduated to any extent from nothing to the maximum, having always a uniform pressure on all the brake beams throughout the train, while in the Steel-McInnes the communication between the main reservoir and brake cylinder is always cut off when the brake is applied, and the volume of air under each car being entirely independent of that under every other car, the acting pressure on each individual brake cylinder will be dependent on the comparative distance which the piston travels in its own cylinder, and too when the air in the brake cylinders is partially reduced in pressure so that it becomes necessary to apply the maximum pressure (requiring a recharging of the reservoir on the brake cylinder). The Steel-McInnes brake requires the release of all the brakes, it being in this respect in quite close relationship to the Westinghouse brake. The construction of the Steel-McInnes brake, using a main reservoir and expanding the air in the brake cylinder, requires from 60 to 80 per cent. greater air pressure at the air compressor than what is obtained in the brake cylinder. In mine no more is necessary, making a great difference in this respect. I think you will see that there is not the close relationship existing between my brake and the Steel-McInnes that had been supposed.

W. W. HANSCOM.

612 O'Farrell street, San Francisco, Cal.

Death of Charles T. Parry.

Charles T. Parry, the senior member of the firm of Burnham, Parry, Williams & Co., proprietors of the Baldwin Locomotive Works, died at Beach Haven, July 18, in the sixty-sixth year of his age. Mr. Parry has been connected with the Baldwin Locomotive Works all his working life-time, and a great portion of the mechanical success achieved by that great manufacturing establishment is due to the constructive ability, liberality and progressive views of the senior member of the firm, who, unlike nearly all old men, was never a brake on the car of progress.

In the year 1836, when he was fifteen years of age, Mr. Parry entered as an apprentice the pattern shop of the works operated by Mr. Matthias W. Baldwin, in Philadelphia. The works were then of very modest dimensions, but a new shop had been erected in Broad street the previous year, devoted exclusively to locomotive building, and there were good prospects of the business proving permanent. Mr. Baldwin had already obtained considerable popularity for the efficiency of the engines he had turned out, and for the improved features peculiar to his productions. The first boom in locomotive building that America has seen came round in the first year Mr. Parry was in the Baldwin works, for forty engines were built that year, the greatest number previously built in any shop in America having been fourteen.

Mr. Parry as a workman was one of the class of men who make their work their most important business, but he also labored in his leisure hours to give himself the training and instruction that would recommend him to a position higher than that of a good mechanic. Although he received no technical training at school, he made such good use of his leisure during his apprenticeship, that at its finish he was promoted and was able to fill acceptably the position of chief draftsman. This position was so satisfactorily filled, and he displayed so much executive ability, besides being a skilfull designer, that within a few years he was promoted to be general superintendent of the works. Mr. Parry continued to be general superintendent till after Mr. Baldwin's death in 1867. At the reorganization of the firm shortly afterwards, Mr. Parry became associated with Messrs. Baird and Burnham in the general management of the company, but he always displayed an active interest in the constructive department. As frequently happens with other leading members of companies, the mechanical ability of Mr. Parry became the property of the firm, and his individual work reflected credit merely on the company but there is no question that his labor did much to help along American railway machinery in the race of progress and improvement it maintained so successfully during Mr. Parry's life-time. He was a good representative of the silent worker, making his mark quietly, but seeking no public credit or acknowledgment of his efforts, the kind of man essential to success in every line of business.

Mr. Parry had been an invalid for over a year and his death was not unexpected. Socially and as a public man he held a high place in Philadelphia, and his death will be a serious loss to the community.

Rules of the Northern Pacific Railroad for the Use of Westinghouse Air Brakes.

GENERAL INSTRUCTIONS.

To Engineers, Trainmen and Inspectors.

1. In making up trains, all couplings must be united so that the brakes will apply throughout the entire train. The cocks in the brake-pipe must be opened (handles pointing down), except that on the rear of the last car, which must be closed.

In coupling hose place the coupling shoulders, near the stop-pin, firmly together, then roll the heads into place as if they turned on a pivot, firmly pressing the heads towards each other until both heads strike the stop-pins.

2. In detaching engines or cars, the couplings must invariably be parted by hand; the cocks in the main brake-pipe, behind hose, must always be closed *before* separating the couplings, to prevent application of the brakes. See Rule 19.

3. If the brakes become set when the engine is not attached to the train they can be released *from passenger cars*, by opening the *air-cock under each auxiliary reservoir*; and on freight cars by placing the four-way cock in the midway (\) position (cut out). See Rule 7.

4. The adjustment of brake-gear should be such that, when the brakes are full on, the pistons of the brake-cylinders will not have traveled to exceed eight inches. This will allow for wearing of shoes, stretching of rods, springing of brake-beam, etc.

5. Great care must be exercised, when taking up the slack in the brake connections, to have the levers and pistons *pushed back to their proper place*; and the slack taken up by the under connections or dead levers.

6. The brake-cylinders must always be kept clean, so that they will rapidly release when the air has been discharged, and should be oiled once a month. The last date of oiling should be marked on the cylinder with chalk.

NOTE.—When necessary to remove the triple-valve cap on freight cars for any purpose, be certain to replace it right side up, as a failure to do so will render the automatic system useless on car affected.

7. For the automatic brake the handle of the four-way cock on triple-valve may be turned *horizontally*. If turned down (|) it will be changed to straight air-brake, if turned *midway* (\) between these two positions it will close communication with the brake-cylinder and reservoir, and should be so turned when desirable to have the brakes out of use on any particular car, on account of the breaking of rods, etc. It is very important, in order to avoid detentions, to keep the handles of these four-way cocks in their proper positions.

8. When desirable to use *straight air* (non-automatic), turn the *handles* of the *triple-valves down* (|) on all the cars in the train, except those which may be cut out of the use of air.

Cars using air must all be set either for automatic or straight air, as the two systems will not work together in the same train. See Rule 7.

Straight Air.

9. The term "Straight Air" is used to designate the original Westinghouse air-system, which operates by applying the air pressure from the engine reservoir directly through pipes to the brake-cylinders of cars, and pressure is released by the air returning to the engineer's valve, when it is placed in proper position, and there passing out. The use of straight air does not require the air storage, or auxiliary, reservoir on cars, of the triple-valve, or pressure-retaining valve; hence when handle or triple-valve, four-way cock, is in downward (|) position (straight air), all of these are out of use. See Rule 7.

Automatic Air.

10. The term "Automatic" (self acting) air brake is applied to the modern Westinghouse system in which the auxiliary reservoir (air storage on cars) and triple-valve come into operation. The self-acting principle is in the triple-valve which operates internally whenever air is released, by the breaking of air pipe, or hose, or the separation of hose coupling, so as to apply the brakes without the aid of other machinery or of help of man. The handle of triple-valve, four-way cock, placed horizontally (—), see Rule 7, makes the air automatic in action. See Rule 41.

Pressure Retaining Valves.

11. This valve is attached, under each car, by a small pipe leading to the release port side of the triple-valve. It can be used *only when operating automatic air* and only when descending mountain grades.

Operation of Pressure Retaining Valves.

12. In operating the pressure retaining valves the plug handle of same must be placed horizontally (—), and ten pounds pressure of air is retained on the brakes constantly by means of the weighted valve contained in the valve case, which has to be lifted whenever any of the air pressure is exhausted.

The small openings in the body of the pressure retaining valves serve as air exhaust passages, when used automatically, and must always be kept open.

To Cut Out the Pressure Retaining Valve.

13. Cut out the pressure retaining valve by turning its plug handle down (|), *in which position it must always remain when not in operation.*

14. In cold weather the triple-valve should be drained frequently, to let out any water that may have collected. Slack the bottom nut of the triple-valve about half a turn, let the water escape, and screw it up again.

15. The main pipe on the tender should be provided with a separate drain-cup with a cock, so that it can be *drained daily in cold weather.*

16. The conductor's valve, for the application of the air-brakes from the inside of the car, should be kept tight, and must be examined by the inspectors.

17. The pipes and joints must be kept tight, and when leaks are discovered they should be corrected, if serious, *before the car is used again.*

Train Men and Engineers.

18. After making up or adding to a drain, or after a change of engines, the rear brakeman shall ascertain whether the brake is connected throughout the train. The engineer must, under these circumstances, always test the brakes, to insure their being properly coupled and in order for use.

19. When hose couplings are not used for connecting the brakes between two vehicles, they must be attached to their dummy couplings.

20. When there is occasion to apply the brakes from the cars the conductor's valve must be held open, to allow the air to escape, until the train is brought to a standstill, but this method of application should *only be used in cases of emergency.*

21. Train men must in all cases see that the hand-brakes are off before starting.

22. The discovery of a defect in the brake apparatus affecting it's working, either before or during a trip, must at once be made known to all train men and the engineer, and a proper understanding had in regard to same, to insure safety and personal convenience in handling the train. All train men are equally interested and responsible in such cases.

23. Under ordinary circumstances, before detaching the engine or any cars, the brakes must be fully released on the whole train. Neglecting this precaution, or setting the brakes by opening a valve or cock when the engine is detached, may cause serious inconvenience in switching. Hand-brakes must always be set on air-brake cars set out at intermediate stations.

Changing Engines.

24. In changing engines it may occur that the one taken on will not have as great air pressure as the engine taken off from the train, and in such case it will be found, when coupled, that all the brakes in the train will be applied, and it may take too long to pump up the difference in pressure on engine necessary to overcome the extra pressure in reservoirs of cars. In such case, on passenger trains, *open the release cock on the auxiliary reservoir* until the air releases through the triple-valve in its natural manner. When this point is reached, close the cock in auxiliary reservoir. The time this will take will vary from one to four seconds to each car as difference in pressure may require.

Do not open the release-cock on brake-cylinder, for this may require repeating several times before sufficient reduction in air pressure is reached. A good plan, in these cases, is to commence at head end of train and first ascertain if the engine is *properly supplied with air*, as in case it is not it may be necessary, and *is quite important on a heavy grade*, to leave the brakes set until there can be a good pressure obtained on engine reservoir. After this is assured release the pressure on cars as above stated. *As this refers to a difficulty most frequently experienced trainmen should understand about how to act.*

Break-in-two of Train.

25. In case a train breaks in two the *brakeman should close the stop-cock on the rear car* of the part of the train remaining attached to the engine, when he reaches it, and then give the engineer signal to let the brakes off.

When cars are again properly coupled up *before opening the air into the rear end of the train* the brakeman should give the engineer the signal to set brakes, which should be done strong, and be left on until brakeman opens the air-cocks into rear section of train. When this is done engineer will have regained control of the air in entire train as before the break in two.

This action will save valuable time which otherwise may be spent in releasing the air on each car by hand.

Automatic Air Train Signals.

26. All passenger cars, and cars used in passenger trains, are equipped with the air signal attached to the engine.

When it is desired to give a signal to the engineer the car signal valve, placed just over one of the car end doors, is opened by pulling the cord. This permits the air to escape, lessens pressure in main pipe and releases air from the signaling reservoir, which passes through the diaphram to the whistle in engine cab.

The breaking in two, or separating of hose connections, operates this whistle automatically in the same manner as the automatic air is operated on train brakes, and is as certain in its operation.

Signals from cars may be given as rapidly as desired, up to four (4) per second.

In case there should be dirt lodged under the signaling valve the escape of air will cause the whistle on engine to sound continuously, and in this case the small cock placed in the connecting pipe, over car door, should be shut off. This cuts out the signal on the one car shut off only, and all others in train may be operated regardless of the defective signal valve.

The closing of this cock will enable the signal valve to be removed for cleaning while the train is in motion and air pressure is on signal apparatus.

Any defects discovered in the signaling apparatus should at once be reported for repairs.

Engineers.

27. When starting air-pump, engineers must allow the water to escape gradually, and not force it out by running the pump with full steam pressure. *Start up slowly; increase speed gradually.*

28. See that steam cylinder is kept lubricated with cylinder oil and that air-cylinder is sparingly lubricated with a small quantity of engine oil.

Tallow and lard oils must not be used in the air-cylinder.

29. The air-cylinder must be oiled through the small cup provided for the purpose. The practice of having oils sucked from a dish into the lower end of an air-pump serves to gum up the valves and air passages, and the relief, which is in this manner at times sought, from heating of cylinder is only temporary at best.

In case air pump does get hot in operation on road use a small amount of valve oil, *not tallow*, to overcome the difficulty temporarily. Head-light oils will cut the gum out, but except it is very thoroughly cleaned out, will cause heating worse than before, and is bad oil to use on this account.

30. The best means for cleaning out air-pump thoroughly, and it should be done at shops, is to disconnect the discharge pipe and pump through a few quarts of weak lye, discharging into a proper dish and pumping it through again until all passages are thoroughly cleaned. After the lye use clean warm water, to thoroughly clean out all passages, then remove the lower head, shove the piston to the upper head and oil the cylinder bore with oily waste.

This occasionally done at shops will insure good working air-cylinders.

31. Run the pump constantly, but never faster than to maintain the required air pressure. Have the governor set to maintain, *on all passenger or freight trains, 80 pounds.*

32. *All engines must have the same air pressure*, regulated by the governor, and if any variation is noted report must be made of it on repair register book.

The pump governor must be used constantly. Pressure gauge must always show pressure on reservoir.

33. For ordinary stops the brakes should be applied lightly, by opening the engineer's valve and closing again slowly, until the pressure has been reduced on the gauge from four to eight pounds.

34. The brakes are *fully applied* when the pressure, as shown on the gauge, is reduced twenty pounds. *Any further reduction is a waste of air.*

35. In releasing the brakes the handle of the brake-valve must be moved quite *against the stop*, and be kept there for five seconds, and then moved back against the intermediate stop, which is the feed position, and where it must remain while the train is running.

The handle must never be left midway between the two stops, as this will nearly, if not quite, close the passage to the train pipe.

36. Engineers upon finding that the brakes have been applied by the train men, or automatically, must at once aid in stopping the train by turning the handle of the brake-valve toward the right, thus preventing the escape of air from the main reservoir.

37. Engineers of all trains must *avoid making exhibition stops* and must never, except on a heavy grade, or in case of necessity, hold the brakes fully applied until the train comes to a full stop, as this causes a reaction in motion of train which is very disagreeable to passengers, and in case of a long freight or stock train, is damaging where there is much slack in the couplings.

This can be avoided, ordinarily, on passenger trains, by releasing brakes gradually before a full stop, so that all the air will be off at the moment stop is made.

38. *No man is fully competent in use of air brakes who does not study and practice this point*, and especially is he incompetent to handle passenger trains.

39. It is important to drain the water out of the main reservoir once a week, and in winter time daily. If the pump-rod is not kept well packed, water will collect in main reservoir freely.

40. If cars having different air pressure are coupled together, the brakes will apply themselves on those having the highest pressure. To insure the certain release of all the brakes in the train, as also that trains may be charged quickly, *the engineer must carry the maximum pressure in the main reservoir before connecting to a train*, and then put the handle of his brake-valve in the release position until the train is charged with air. If the brakes on the engine and tender thus apply themselves by being coupled to a train not charged, they should at once be taken off by opening the release-cock from the auxiliary reservoir. See Rule 3.

41. Automatic brakes are applied when the pressure in the brake-pipe is suddenly reduced, and released when the pressure is restored.

42. It is of very great importance that every engineer should bear in mind that the air pressure may sometimes reduce slowly, owing to the steam pressure getting low, or from the stopping of the pump, or from a leakage in some of the pipes when one or more cars are detached for switching purposes, and that in consequence it has been found absolutely necessary to provide each cylinder with what is called a leakage groove, which permits a slight pressure to escape without moving the piston, thus preventing the application of the brakes when the pressure is slowly reduced, as would result from any of the above causes.

43. This provision for the accidental application of the brakes must be taken into consideration, or else it will sometimes happen that all the brakes will not be applied when such is the intention, simply because the air has been so slowly discharged from the brake-pipe that it only represents a considerable leakage, and thus allows the air under some of the cars to be wasted.

44. It is thus very essential to discharge enough air in the first instance, and with sufficient rapidity, to cause all the leakage grooves to be closed, which will remain closed until the brakes have been released. See Rule 33.

In no case should the reduction in the brake-pipe for closing the leakage grooves be less than four or five pounds, which will move all pistons out so that the brake-shoes will be only slightly bearing against the wheels. After this first reduction, the pressure can be reduced to suit the circumstances. See Rule 34.

45. On a long train, if the engineer's brake valve be opened suddenly and then quickly closed, the pressure in the brake-pipe, as indicated by the gauge, will be suddenly and considerably reduced on the engine, and will then be increased by the air pressurre coming from the rear of the train, hence it is important to always close the engineer's brake-valve slowly and in such a manner that the pressure, as indicated by the gauge, will not be increased, or else the brakes on the engine and tender, and sometimes on the first one or two cars, will come off when they should remain on.

46. On long down grades it is important to be able to control the speed of the train, and at the same time to maintain good working pressure. This is easily accomplished by running the pump at a good speed, so that the main reservoir will accumulate a high pressure while the brakes are on. When, after using the brakes some time, the pressure has been reduced to sixty pounds, the train pipes and reservoirs should be recharged as much as possible before the speed has increased to the maximum allowed. A greater time for recharging is obtained by considerably reducing the speed of the train just before recharging, and by taking advantage of the variation of the grades.

47. To release the brakes with certainty it is important to have a higher pressure in the main reservoir than in the main pipe.

If the engineer feels that some of the brakes are not off it is best to turn the handle of the engineer's brake-valve just far enough to shut off the main reservoir, and then pump up fifteen or twenty pounds extra, which will insure the release of all the brakes, all of which can be done while the train is in motion.

Air-Gauge Cock.

48. Attached to the engineer's brake-valve, at the point where the air passes from the valve to the air-gauge, is a small cock called "Air-Gauge Cock."

Its use is to turn the air into the gauge, whether running with "straight" or "automatic" air.

When using automatic air place the handle in position to open the passage from engineer's valve to the gauge.

When using straight air open the passage from the main reservoir to the gauge.

Mountain Grades.

49. Before starting up or down grades which exceed one hundred feet per mile and one-half mile in length, examine brakes and air apparatus carefully.

50. Going down grade, examine the shifting links, nuts, bolts and connections of same, to insure their being in order for reversing engine, and the use of water-brake.

Pressure Retaining Valves.

51. On long mountain grades it will be necessary to have the pressure retaining valves put into use on the train. These are set to retain (10) pounds pressure on the brakes, and are in operation only with automatic air, and when its plug handle is placed horizontally (—).

The use of the pressure retaining valves enables the engineer to keep up the pressure of air in the reservoir for a considerable time *descending mountain grades and must not be used elsewhere.* See Rules 11, 12 and 13.

Engines Coupled on Mountain Grades.

52. When two air-brake engines are coupled to a train the *forward engine must control the air-brake*, but both engines should be coupled up to the air-pipes, and may be used to pump air into the train auxiliary reservoirs, in case it is desired to do so, when train is not in motion.

When train is in motion the rear engineer must "blank the air" by turning the valve to the right, nearly to the point of application, *and let the leading engineer do all the braking.*

Otherwise the brakes may all be pumped off by the rear engineer, very soon after the brakes are applied by the first engineer, and this will render the brakes useless. Hence the leading engines must control the train brakes entirely and absolutely, except in case of accident to air of leading engine, and until a proper signal is given by the first engineer for the second engineer to assume control of the air-brakes on train, for which contingency the second engineer must at every moment be *prepared to act instantly on a mountain grade.*

Whistle Signal.

Two short full blasts with one long blast (— — — —) is signal that for some cause the air on leading engine has failed, and it is desired to give up control to the second engineer who, by repeating the signal, signifies that he understands and has control of the air-brakes.

Having assumed control of the brakes the second engineer will *retain entire charge of same to the end of the trip*, except in case of necessity which may reverse the operation.

There must not be any experiment or practice with the air-brake when attached to trains on mountain grades; this must be gone through with at other times.

53. *Have always in mind on mountain grades to keep control of train.*

Descending at high speed must not be practiced with any train, for there may come a time when some part of the machinery may fail, and *while practicable to control speed by hand-brakes at eight to ten miles per hour it may be impossible at twenty to thirty miles per hour to regain its control.*

Driver-Brakes.

54. Adjust the driver-brake shoes so that the piston will have a motion of from one inch to one and one-half inches, never more than the last figure. This is done by changing the screws provided for the purpose.

55. Driver-brakes must be used daily, at points to be named by the Master Mechanic, on all engines fitted with them, and sufficient to insure their being in good working order.

56. Any defect in the working of driver-brake must be reported by engineer in the general report of defects in brakes.

57. *It is not designed to use driver-brakes in stops of trains, except in cases of necessity*, as their use causes a shock on the cars disagreeable to occupants of passenger trains.

58. When driver-brakes are, from necessity, used on engines attached to passenger or other trains, they should be released gradually and before a full final stop is made.

This course will lessen very greatly the effect of shock on cars

59. *Engines must not be reversed with driver-brakes set.*

60. A too free use of the driver-brake on mountain grades heats the tires of driving wheels, expands and loosens them on wheel centers, and this not only destroys their brake efficiency, but will make engine useless for draft purposss also.

61. It must be remembered that water-brake acts on the drivers and that the combined use of water-brake and driver-brake will be too great, causing the sliding of wheels, hence the combined use of water and driver-brake must not be made.

Water-Brakes.

62. The "Le Chatelier" (water) brake is, on this road, intended to be used as auxiliary to other brakes, and when used with discretion is a valuable aid in steadying an engine down mountain grades.

It is most effective on a steady motion of from three to twelve miles per hour, above which latter speed it is of lessened value.

It should not be used at a greater speed than eighteen miles per hour, *and is for mountain work only.*

Operation of Water-Brake.

63. Water is led by a small pipe connected to the boiler, below water line of same, to the exhaust-pipe cavity and through to the cylinders.

This affords a counter pressure on pistons when engine is reversed, which should be just back of the center notch of quadrant. The act of forcing compressed moist vapor—which the water jet drawn into the cylinders, with engine reversed, supplies—back into the boiler causes the retarding force on pistons, operating, through the connections, on crank-pins and gives the desired brake power.

Only a very small amount of water is used, a portion of which, except that put into vapor and returned to boiler, passes through the open cylinder-cocks.

The amount of force or brake power exerted depends upon the position of the reverse lever.

The following rules in the use of the water-brake *must be observed*:

64. First have engine in slow motion without steam, have cylinder cocks wide open and keep them open, with reverse lever placed one notch back of the center and throttle securely shut. Give the small water-cock a sixteenth or one eighth of a full turn open and notice that steam-water passes the cylinder-cocks freely.

The speed may now be regulated by placing the lever back as required and should be done without any change in the water-cock.

A too free use of water is dangerous to cylinder-heads, and water may be forced out of the smoke stack, and does not produce any useful effect.

In shutting off the water-brake throw the reverse lever ahead slowly, *first closing the water-cock*, to avoid throwing water from the stack.

Light engines, when fitted with air or steam brakes and water-brakes, are best controlled by setting the water-brake moderately and using the air or steam tender brake to regulate speed.

In cases of necessity the water-brake, the train-brake and all other available means may be used together.

Alway be careful, however, in setting water-brakes.

G. W. CUSHING,
Supt. M. P., M. and R. S.

Approved:
T. F. OAKES,
Vice-President and General Manager.

Railway Master Mechanics' Association.

REPORT OF COMMITTEE ON CYLINDER PACKING.

PART I.

The committee of research to whom was referred the subject of cylinder packing beg leave to offer the subjoined report:

A series of inquiries, embracing some of the important points bearing upon the question, were prepared by the committee and sent to the members by the secretary; replies were received from the following named persons: J. Davis Barnett, Grand Trunk, of Canada; J. N. Lauder, Old Colony; Thos. B. Twombly, Chicago, Rock Island & Pacific; G. H. Prescott, Terre Haute & Indianapolis; H. Schlacks, Illinois Central; James Meehan, Cincinnati, New Orleans & Texas Pacific; Allen Cooke, Chicago & Eastern Illinois; A. Griggs, Providence & Worcester; F. G. Brownell, Burlington & Lamoille; John S. Cook, Georgia; W. H. Thomas, East Tennessee, Virginia & Georgia; E. L. Weisgerber, Baltimore & Ohio; C. C. Hobart, Oregon Railway & Navigation Company; A. Hendee, Jacksonville, Tampa & Key West; G. W. Ettenger, Newport News & Mississippi Valley; John Player, Central Iowa; W. C. Ennis, New York, Susquehanna & Western; John McGrayel, Des Moines & Fort Dodge; E. G. Wheeler, Chicago, St. Paul & Kansas City; John W. McKenzie, New York, Chicago & St. Louis; L. Finley, Hot Springs; W. H. Stearns, Connecticut River.

To the first question—"Do you use cast iron for packing rings?"—all reply in the affirmative; four report using what is known as Dunbar's packing; 18 report using cast-iron rings cut in one place only.

To the second and third questions—"What width and what thickness are rings when first applied?"—a diversity of answers were received; four report using rings ¾ in. wide and ⅜ in. thick; three are using rings ⅝ in. wide and ⅜ in. thick; two use the Dunbar packing ⅞ in. wide; one uses Dunbar packing ⅝ in. wide; one uses Dunbar packing 1 in. thick; one uses rings ⅝ in. wide and ⅝ in. thick; two use rings ⅞ in. wide and ⅝ in. thick; two use rings ½ in. wide and ½ in. thick; one reports using rings 7/16 in. wide and 7/16 in. thick; one reports using rings ⅞ in. wide and ¾ in. thick; one uses rings 1 in. wide and ⅝ in. thick; one uses rings ¾ in. wide and ⅝ in. thick; one uses ⅝ in. by ⅝ in.; one ¾ in. by 13/16 in.

To the fourth question—"How much larger than the cylinder are the rings when first put in?"—there is a difference in sizes given. Two say ⅜ in., one says 3/16 in., four say ¼ in., four say 5/16 in., one says ⅛ in.—all reports varying the amount according to the sizes of the cylinder. Those who are using the Dunbar packing report making same to the size of a cylinder. Two give no statement as to how much larger, if any, the rings are made.

To the fifth question—"Do you, after turning up the rings, cut them, spring them in and true them up to the correct size of the cylinders?"—18 say they do not; four say they do.

To the sixth question—"Are rings made heavier opposite to where they are cut?"—17 reply no; six say yes.

To the seventh question—"What is your usual plan for breaking joints?"—the replies indicate a variety of plans. Mr. J. Davis Barnett reports that his usual plan is to have the two rings break joints at 90 degrees from each other, each being held in place by ⅜ dowel pins screwed radially into the piston head 45 degrees from the bottom of the cylinder.

Mr. H. Schlacks reports that originally his plan was to place both openings on the bottom of the cylinder, making the joint with the T ring, which by this method formed a perfectly tight joint; experience indicated that this practice caused a ridge to be worn throughout the entire length of the cylinder, between the openings in the rings, and he has now adopted the plan of having the two rings break joints at 90 degrees from one another, each being held in place by a ⅜ dowel inserted into the T ring 45 degrees from the bottom; with this arrangement the cylinders wear somewhat oval but perfectly smooth. Mr. J. N. Lauder mills away part of one side of the packing ring, and rivets one thin piece of iron, as shown on blue print. Mr. C. C. Hobart also mills away part of one side of packing ring as shown on blue print. Mr. John Player cuts the rings diagonally across as shown in blue print. Three members report having the ends of the rings tap half an hour. Eight members report using dowel pins placed near the bottom of the T ring, and inserted into it.

To the eighth question—"Do you use springs to assist in setting out the packing or depend upon the elasticity of the rings assisted by steam?"—18 report that no springs are used, and only those who use the Dunbar packing say that springs are used, although one member suggests that he thinks that the use of springs would be a good practice; and from these it is evident that springs are not necessary.

To the ninth question—"Are more than two rings used in one cylinder?"—21 members report only two being used. Mr. John S. Cook reports that he uses three rings in all of his solid piston heads.

To the tenth question—"Have you tried steel, bronze or gun metal, and if so state results?"—Mr. J. Davis Barnett reports having tried three wrought-iron rings in each piston, 5/16 in. wide by ⅝ in. deep, under the Ramsbottom patent; they did their work well but did not last as long nor keep as tight as cast-iron rings of stouter section; others report formerly using brass or gun metal, but the frequent adjustment required caused the use of them to be discontinued.

To the eleventh question—"Do you use any patented style of packing rings?"—four report the use of the style generally known as Dunbar's, which has been in use for the past 18 years; no other style of patent ring is mentioned, and the general use of a cast-iron ring, cut in one place only, and held in contact with the walls of the cylinder by its own elasticity, is indicated by a large majority of the reports, viz.: 18 out of 22.

To the twelfth question—"Do you use solid heads or spider follower and T ring?"—five say they use and prefer solid heads; 17 use spider follower and T ring. Mr. John S. Cook reports that he uses solid heads with three grooves ½ in. wide and holds the piston centrally by means of brass brushes placed in the stuffing boxes and which are renewed as often as necessary. Mr. James Meehan reports that he uses solid heads and springs the ring into grooves; he thinks they are preferable to spider heads and cheaper. Mr. Schlacks reports that some twelve years ago he commenced using solid cast-iron heads 4½ in. thick, the packing rings being sprung over the head into grooves. He has obtained excellent results from it and prefers it to the spider and follower. First, because there is no danger of the follower bolts working loose, causing the breaking of the cylinder or cylinder head. Second, it is 50 lbs. lighter, that is 140 against 190. Third, it can be fitted up at one-half the expense of the spider and follower, and is less expensive to maintain when it is well designed and cored out, and the walls properly secured by stay bolts tapped through the head; there is no danger of its failing while on the road, as in our entire experience we have not had one give out. On account of the gases which appear to collect in the cavity made by the core we have found it necessary to drill a 3/16 in. vent hole through the wall on one side of the head. Mr. E. L. Weisgerber states that for the past five years he has been using a solid cast-iron head because it can be fitted up for one-half the cost of spider and follower head and there is no liability of the follower bolts working out and causing the breakage of cylinder heads and cylinders. Mr. J. Davis Barnett says, "we use solid heads and spring the rings over into grooves; would recommend a solid piston head, that is a head cast completely in one piece, as if properly designed and cored out it can be made as light in weight as a spider head and at one-quarter its cost; there is less risk of failure in a solid head when it is out on the road at its work; and being cheaper to renew, there is less reluctance felt when the head is worn in throwing it away and putting a new one in."

To the thirteenth question—"What is your general practice for adjusting the piston in the center of the cylinder?"—in 11 reports in which a spider follower and ring is reported to be used, members say they turn out the T ring larger than the arms of spider and line up the piston centrally by means of sheet iron shims placed under the bottom arms, and hold the T ring in place by clamping it with the follower.

To the fourteenth question—"Do you drill small holes in piston to set out the packing?"—All reply no.

To the fifteenth question—"How much side shake do you allow?"—12 report slight side shake as being necessary to prevent rings from sticking with gum from lubricant. Ten members report that no shake is allowed.

To the sixteenth question (which is the most important on the list), "What is your observation as to the wear of cylinders with cast-iron rings as compared with the old style of brass packing?" the replies are very full. Mr. J. Davis Barnett says: "Steam packing did badly bell-mouth the cylinders at each end, and cast iron rings sprung into place have the same tendency, but in a very mild form, so that this defect is the slightest disadvantage yet experienced with any known style of piston packing. Cylinders will run from 150,000 to 200,000 miles without reboring, but I would recommend a very light cut to be taken at every 100,000 miles, as this practice, while reducing the cylinder friction, will not reduce the thickness of the cylinder shell as much as a heavier cut taken at dates further apart." Mr. J. N. Lauder says: "My observation is, that when steam is let under the rings the wear of the cylinder is much greater at the ends than at the center, and I try to exclude the steam as much as possible, but steam will go in at the cut to some extent." Mr. Thomas B. Twombly states: "Cylinders wear out much faster with the old brass packing than with the steam packing. In using steam packing we notice that the cylinders are worn away a great deal more rapidly near the ends, but the packing seems to remain tight, and I do not regard this irregularity as a serious disadvantage. I do not think it necessary to rebore cylinders at any regular periods, but when an engine is in for repairs her cylinders should be inspected and if worn so much that they are no longer capable of rendering good service they should be rebored. We have many cylinders 10 years old which have not yet been rebored." Mr. G. H. Prescott says that with steam packing cylinders wear most at each end and at the bottom. Mr. H. Schlacks reports that in his observations steam packing wears the cylinders more at the ends than in the center, but while he considers this irregularity a disadvantage, experiments have demonstrated that the packing remains tight throughout the entire travel of the piston. Boring depends upon the quality of the metal in the cylinder. Cylinders usually run about 175,000 miles before reboring is found to be necessary. M. John Player says: "With our packing the cylinders wear good and show as even wear from end to end of piston travel. Cylinders need reboring about once in six or seven years, or say after running about 250,000 miles." Mr. A. Griggs states: "I find the spring ring packing to be of great advantage over the old style of brass spring packing, first, because it costs about one-fourth as much; second, because it is automatic, requiring no springs to set it out; third, because it does not require looking at on an average once a year; fourth, when properly fitted up it will run on an average five or six years without renewing, and wear the cylinders comparatively true, showing in that time a difference of not more than 1-16 in. in diameter at the ends and center. Cylinders made of good hard iron will run ten years without reboring, being counter bored once during that time." C. C. Hobart states; "The wear with us is very even, a trifle more, perhaps, at the ends than at the center of the cylinder, due more to pressure of steam than other cause." Mr. E. L. Weisgerber says: "There is less wear with the steam than with the spring packing, from the fact that cylinders are not so liable to get cut, as the rings are free in the cylinder when steam is shut off. We find that cylinders are worn more at the ends, but do not consider this any disadvantage for the reason that the rings are flexible and adjust themselves to irregularities of the cylinders. Cylinders in which steam packing is used require re-boring about every four years." Mr. James Meehan says: "I think better results are obtained from the present style of steam packing. I have not noticed the cylinders wearing any more rapidly than with other packing. Boring depends upon the quality of the metal in the cylinder." Mr. John S. Cook says: "With the cast iron packing we use, we find that our cylinders wear less than with the old style brass ring packing." Mr. W. H. Thomas reports: "Where steam packing is used the cylinders wear largest at the ends, more so than by the use of the old style brass pack with springs; I do not consider this irregularity in the diameter any disadvantage in a packing which is flexible and automatic in its adjustment. Reboring is necessary about once in five years." Mr. G. W. Ettenger says: "Steam packing wears the cylinders less, but not so regularly as the old style brass packing." Mr. W. C. Ennis says: "Cylinders wear faster at the ends than with spring packing, but I think with us very little, as we do not rebore cylinders oftener than once in three years on an average, and our mileage on a heavily graded road averages 2,650 miles per month per engine." Mr. John W. McKenzie says: "Cylinders are worn more at ends, but I do not regard this as a disadvantage with proper lubrication. We rebore about every 100,000 miles." Mr. John McGrayel says: "This style of packing wears a cylinder out of round faster than the old style spring packing or Dunbar, but is much cheaper in first cost and maintenance." Mr. W. H. Stearns says: "Wears most at ends, but gives very little trouble. Cylinders run from 8 to 10 years." The grade of iron preferred for use in packing rings is very similar in all reports, a preference for a tough, elastic and not too hard metal being expressed; some think the ring should be softer than the cylinder, so that the greatest wear will be upon the ring, rather than the cylinder.

Your committee lay these views before you as reported to them by members from various parts of the country, whose statements indicate that the use of narrow cast iron rings, cut only in one place, and which adjust themselves to the walls of the cylinder by their elasticity alone, or by that and as much steam as may leak under the ring through a sliding or a slightly loose ring, have displaced other forms of packing rings; and while the reports also indicate that the cylinders are worn more rapidly at the ends than at the center, by the use of these narrow rings, than was the case with such packing as members used formerly, their great cheapness and long wear, with little attention, have brought them into almost exclusive use as a durable and economical appliance. The reports received from members were very full and instructive, and while the committee have sought to present the information in a form greatly condensed, they trust that enough has been shown to provoke discussion, and only regret that any abridgment was necessary.

PART II.

REPORT OF COMMITTEE ON PISTON ROD AND VALVE STEM PACKING.

Although the committee on cylinder packing and piston rod and valve stem packing were instructed to consider both subjects, on account of the varying character of the two, it has been thought best to treat the latter in a separate report, which is hereby submitted.

A number of questions covering the subject were reported and sent to members, to which replies were received from the following persons: G. W. Ettenger, Newport News & Mississippi Valley; H. Schlacks, Illinois Central; A. Griggs, Providence & Worcester; Allen Cooke, Chicago & Eastern Illinois; A. Hendee, Jacksonville, Tempa & Key West; James Meehan, Cincinnati, New Orleans & Texas Pacific; C. C. Hobart, Oregon Railway & Navigation Co.; Thomas B. Twombly, Chicago, Rock Island & Pacific; E. L. Weisgerber, Baltimore & Ohio; John S. Cook, Georgia; G. H. Prescott, Terre Haute & Indianapolis; W. H. Stearns, Connecticut River; W. H. Thomas, East Tennessee, Virginia & Georgia; John Mackenzie, New York, Chicago & St. Louis; F. G. Brownell, Burlington & Lamoille; J. N. Lauder, Old Colony; John Player, Central Iowa; John Grayel, Des Moines & Fort Dodge; M. C. Wheeler, Chicago, St. Paul & Kansas City; F. L. Wanklyn, Grand Trunk of Canada, and W. C. Ennis, New York, Susquehanna & Western.

As the replies are all very interesting, the committee regrets that any abridgment was necessary, and have endeavored to present the most instructive parts for the information of the members.

To the first question, "Do you use hemp exclusively?" only three reply in the affirmative. Others say that hemp is more or less used. Many indicate that a better substitute is being sought because different forms of metallic packing are being used; while some have entirely discontinued the use of hemp. The committee think that the purpose of this report will be best accomplished by giving the exact replies as given in these reports upon the most pertinent points of the subject.

G. W. Ettenger reports that he uses soapstone with gum core with fair results. The cost per 1,000 miles for passengers, is 16¾ cents; for freight, 47¼ cents. He is now experimenting with metallic packing, but thus far their experiments have not gone far enough to definitely state results.

A. Griggs reports that he is using Eagle packing and likes it. The cost per 1,000 miles for Eagle packing is 13¼ cents. Cost per 1,000 miles for various kinds of packing, including hemp, Silver Lake and Schœnix, 28⅓.

H. Schlacks reports: "We are using the Jerome metallic packing on the pistons and valve stems of all, or nearly all, of the engines upon the Illinois Central system, and with excellent results. The first cost of equipping an engine is about $13 and it runs from 12 to 14 months without being renewed. The cost of the metallic rings is slight. The wear on both piston rods and valve stems is slight, the wear on valve stem being greater than on piston rods. The lifetime of any packing depends greatly on the attention it receives from the engineer. We are experimenting with a valve stem packing that has been adopted by the C., R. I. & P., consisting of three babbitt rings, each cut in three sections, and secured by a band of steel, and placed inside of a rubber sleeve. This has given very good results thus far. We are also experimenting with metallic packing and the Sleeper metallic packing, but they have not been in use long enough to report definitely upon their merits. We find it somewhat more difficult to keep valve stem packing tight on account of the variation in the length of the stroke, and on account of the upward and downward movement imparted to it by the rocker arm."

A. Hendee reports: "We use, as a rule, 'Eagle packing,' for pistons and valve stems, except on one engine which has 'United States' Packing, which has thus far given good satisfaction."

Jas. Meehan reports that he is "using hemp, also Deed's, Jerome's, and the United States metallic packing. During 1876 hemp cost 33⅓ cents per 1,000 miles. He states that no trouble is experienced in the use of metallic packing. The 'Jerome' requires new rings about once a month at a cost of 40 cents. The 'Deeds' is slightly more expensive. He thinks the 'United States' the better, but has not had either of them in use long enough to state definitely their relative merits.

C. C. Hobart states that he is using mostly the Johns patent metallic packing. It costs on first equipment between $3 and $4 per engine. It makes from 30,000 or 40,000 miles before renewals are required, the wear on rods and stems is very slight, and they are bright and smooth as a mirror. The composition is one part best Babbitt metal to nine of lead. Finds a little more difficulty in keeping valve stems tight, due to change of stroke.

Thos. B. Twombley report that neither hemp nor any form of fibrous packing is used upon his road. Upon pistons the "Jerome" packing is used, and upon valve stems a design of his own. The first cost of "Jerome" packing per engine is about $11. The cost of maintenance per engine per annum for same about $1.50. The metallic rings need renewal about once in eight months. The valve stem packing is inexpensive and simple. The metallic ring renewal about once in eight months. Composition, antimony 30 parts, lead 70 parts. He says: "With this device we have no difficulty in keeping valve stems tight, but the Jerome packing on valve stems resulted in total failure—caused by the shoulders, which were worn upon the stem by unequal travel. The metallic packing which we use, both for piston rods and valve stems, is eminently satisfactory. I have had rods running in hard service for 17 months, with a reduction in diameter of 1-64th of an inch, and with a surface like glass, valve stems also give us almost no trouble."

E. L. Weisgerber reports that he uses hemp for pumps, and soapstone for pistons and valve stems. The cost per 1,000 miles per engine for soapstone is 25 cents. No metallic packing is used. He states that he thinks that the use of an oil cavity on glands, whereby sufficient lubrication can be secured, prolongs the service of the packing.

John S. Cook says: We have metallic packing on the pistons and valve stems of 25 locomotives; 23 having the "United States" and the "Jerome." I am well pleased with it, and intend to apply it as fast as it can be done economically. On some engines it worked well from the start, which encouraged perseverance, and now it is working satisfactorily on all classes of engines. I enjoy complete immunity from bent piston rods, and find greatly reduced wear on rods and stems.

G. H. Prescott reports that he has placed upon the pistons and vavle stems of about 50 engines on his road a packing invented by R. W. Kilmer, an engineer on his line. He says "the wear on pistons and valve stems is about the same as with hemp, depending greatly upon the attention given it by the engineer. It can be placed in any ordinary stuffing box without change. The cost of a full set for one 11 x 24 engine is $4.00, without royalty. It has not been in use long enough to say whether it is cheaper than hemp," but thinks it is, and it gives less trouble. The composition is ¾ lead, ⅛ blockt in, ⅛ antimony. Owing to the vertical play of the crosshead more difficulty is had in keeping pistons than valve stems tight with this packing.

W. H. Stearns reports that he uses "Silver Lake" and "Prepared" locomotive packings. These compare quite favorably with each other. Upon piston rods he uses the "United States

Metallic Packing." He says if valve stems are held central by the yoke they give very little trouble.

John Mackenzie reports that he uses only hemp on pistons. Upon valve stems he uses three babbitt rings, each ring cut three times, with a rubber sleeve on the outside; this will run 20,000 miles, and by removing the rubber sleeve will run 20,000 miles more. With this packing he finds less trouble on valve stems than pistons.

W. H. Thomas reports that he uses hemp and soapstone, and also finds the "Eagle Packing" very good and serviceable; has used asbestos with good results—a great deal depending on the engineer in its use. He also states that he has in use "United States Metallic Packing" which he has run 100,000 miles without requiring repairs, and he does not see why metallic packings will not give good results on pistons or valve stems, if properly cared for.

F. G. Brownell reports that he has in use upon all engines on his road the "Brownell Patent Packing," for the past year, and upon some engines in an adjoining road, which come under his charge for six months. They are all giving the best satisfaction. Asbestos costs 10 cents per 1,000 miles. Soapstone and flax as high as $2 per month on some engines.

J. N. Lauder reports that he uses hemp to some extent, but uses none of the prepared fibrous packing and especially avoids the use of rubber. Upon his road the "United States Metallic Packing" is largely used.

John Player reports that upon his road he uses a metallic packing of his own design exclusively, the cost for a full set for one 17 × 24 engine is $7. The brass rings do not wear and need no renewal. The cost for 1886 for Babbitt rings and asbestos for renewals was $2.10 per engine. Average mileage 33,900, or a little less than 6¼ cents per 1,000 miles. The packing runs equally on valve stems or piston rods. No trouble in keeping it tight. Composition, tin eighty parts, antimony ten parts, copper one part. "Have been using this packing for the past seven years, and experience proves the wear on rods and stems to be exceedingly small."

John McGrayel reports that on piston rods he uses "Jerome's Metallic packing and that it gives entire satisfaction, more especially in the wear of rods which run about 150,000 miles between turnings, and the reduction in diameter is usually not more than one-sixteenth of an inch. Its first cost is $15 per engine and ten cents per 1,000 miles will keep it in repair until rods need turning. "On valve stems we use asbestos, and with proper care by engineers it will run six months, with one packing, we have not had very good success with metallic packing with valve stems."

M. C. Wheeler reports that he is using hemp mostly, "have been using Mr. John Player's Metallic Packing. Can give no data of comparison as yet."

F. L. Wanklyn, of the Grand Trunk, sends in a tabular statement. He says, "so favorable has the experiment been in the use of this packing with us, which dates from the beginning of 1882 that I have orders to equip all our standard engines, passenger, freight and shunting with it. The packing is known as the United States Metallic Packing, and the company is authorized to manufacture it under royalty. The introduction of metallic packing into the glands of the air pumps was an idea of our own which has since been taken up by the U. S. Metallic Packing Co. The opinion of enginemen, running engines equipped with this packing is most favorable. An inspection of the tabulated statement will show the extraordinary mileage between renewals made by this packing.

W. H. Ennis reports that he has used "American," "Italian" and "Tallowed" hemp" Silver Lake," "Dirigo" and "Soapstone" packing, also "Eagle Packing." He finds the "Eagle" gives the best results of this class of packing. The cost of "Tallowed hemp" and "Eagle Packing" for one year ending Oct. 1, 1886, for each engine upon which it was used was 78 cents. He reports having tried one set of "Bold's Patent Metallic Packing" made at St. Louis. It gives fair satisfaction so far as freedom from blowing is concerned, "but is expensive for renewal of the metallic packing. We also have one set of the United States Metallic Packing, which has run for one year, and has given good satisfaction. We have now on trial two sets of Excelsior Metallic Packing, made at Middletown, N. Y., that have been in use for some months, thus far requiring no repairs."

The reports show conclusively that there are forms of metallic packing now being used, which are giving very satisfactory results, costing less for renewals than the current cost of hemp and also wearing rods and stems much less than fibrous packings, and although some report more definitely their success than others, no instance is given where, after trial, the attempt to use metallic packings has been discontinued. The greatest success must always follow when the required conditions are most fairly met, those in rod and stem packing are, as tersely stated by Robert Grimshaw in "The Steam Engine Catechism:" "A piston rod packing must allow the rod to move freely up, down or sidewise with little friction, with little wear of the rod, or of the packing, and must make a steam tight joint under the highest pressure that there will be found in the cylinder." The blue prints and sketches contributed by members are submitted as a part of this report, and will be found to be well worthy of being engraved and embodied in the report of the proceedings of this body.

J. W. STOKES,
ALLEN COOKE,
HENRY SCHLACKS, *Committee.*

Mr. J. W. Stokes (Ohio & Mississippi) found that surprising progress had been made in the last four years towards introducing improved forms of gland packing. Four years ago, a large majority of the members were using hemp, but now there are scarcely any master mechanics who are not experimenting to find something cheaper and more satisfactory. Aside from the difference in shaping and applying, all who are using metallic packing use it very much on the same plan. Nearly all use some form of ring with a spring behind it. Some use a rubber spring, others a coil spring. The most successful forms of packing are those in which the ring would move up and down.

REPORT OF COMMITTEE ON CONTROL BY ENGINEER OF WEAR OF TIRES.

To the American Railway Master Mechanics' Association:

The undersigned committee on the subject: "Has the locomotive engineer any control over the wear of tires?" beg leave to submit the following report:

Only 17 replies were received to the circular sent out, a summary of which is given below.

1st question: "Has the locomotive engineer any control over the wear of tires?"

a. Sixteen roads answer, "Yes."

2d question: "If so, in what way?"

a. One road answers: By using too much throttle.

b. Eleven roads answer: By slipping the wheels unnecessarily, causing wear over which the engineer has control.

c. Three roads answer: By the judicious and proper use of sand.

3d question: "What is your method of determining the wear of tires?"

a. Twelve roads answer: By measuring the thickness of tires between turnings and taking the mileage per 1-16 inch wear.

b. Three roads answer: Have no regular means of determining the wear of tires.

c. One road answers: We take a record at the close of each month by plaster paris mold, showing the exact condition of tires.

d. One road answers: We take a record with an indicator showing the wear on a card; in this case the chart can be taken at any time, but the rule is every three months, or when the assignment of engineers is changed.

4th question: "Do you have regular engineers on your locomotives?"

a. Fifteen roads answer: Yes.

b. One road answers: We make a practice as far as possible of keeping regular engineers on our locomotives, and think it very advisable to do so.

c. One road answers: We keep regular engineers on all our locomotives. We find it economy to do this, especially where shops are located in center of road; but where shops are located at end of road we think it more economical to place two engineers in charge of one locomotive (passenger only), and each to make a round trip alternately. It creates a competition as to which shall keep the engine in the best condition, as they know the engine will be closely inspected at the end of each trip, and in consequence will do more work on an engine.

5th question: "Will tires run longer between turnings with regular engineers than with different engineers?"

a. Four roads answer: Yes.

b. Four roads answer: Yes, and the reason for this is that the regular man learns to take advantage of any peculiarities in the working of the machine, which the extra man may or may not discover, and as a consequence there is less grinding and slipping tires.

c. One road answers: Yes, and we will do better service and with less expense.

d. One road answers: Yes, from the fact that different men run the same engine in different ways, and on this tire question depends the handling of an engine.

e. Two roads answer: Do not know.

f. One road answers: With two regular men alternating on the same engine there is no difference, but with numerous changes on the same engine the deterioration, not only of the tires, but of the whole engine, is rapid.

g. One road answers: No difference when the engine is properly loaded.

h. One road answers: No, not on a mileage basis.

i. One road answers: One division says, everything being equal, there is no difference. The other division says there is a difference—tires will run longer with regular engineers than with changing. The master mechanic of this road says there is no doubt but what tires will run longer with regular engineers than by changing.

6th question: Is a free use of sand desirable or not as regards the wear of tires? Give figures is possible, if not, the experience of yourself or engineers.

a. Two roads answer: It is desirable.

b. Five roads answer: Avoid using sand if possible.

c. Four roads answer: A judicious use of sand is desirable; that is, sand enough to prevent slipping. We believe a small amount of sand will prevent slipping better than an excessive amount. When an engine is bound to slip we would use a small quantity of sand, and as little as could be got along with. As we understand the term, we can hardly say we are in favor of a free use of sand.

d. One road answers: Sand wears out more tires than work does, on this road; and with heavy engines 50 per cent. or more of work could be done with the same tires between turnings.

e. One road answers: If engine is over-cylindered or under-weighted, a liberal but judicial use of sand will do less injury to tires and engine generally than a chronic state of slipping.

f. One road answers: No; a free use of sand is not desirable, for the wear of tires due to slip without sand is less than the wear due to the grinding action of sand, which but partially arrests or prevents the slipping of drivers.

g. One road answers: Have no figures as regards the wear of tires from the use of sand, but my opinion is that its excessive use is very disastrous to the life of a tire, and that its entire discontinuance is to be desired.

h. One road answers: Sand has an injurious effect on the tires as well as increasing the resistance of the train. The following is taken from a report made from a record on this road: Two mogul engines, 19x24 cylinders, weight on drivers, 79,000 lbs.; weight on truck, 16,000 lbs.; total, 95,000 lbs. Both had Krupp tires. The first engine made a total mileage of 50,444 miles to wear of 4-16 in.; mileage per 1-16 wear, 12,611. The second engine made a total mileage of 47,087 miles to a wear of 2-16 in.; mileage per 1-16 wear 23,544. The first engine was in charge of several engineers, who, as the report says, used sand freely. The latter engine was in charge of a regular engineer whom the master mechanic knew to be extremely careful, avoiding the indiscriminate use of sand. The result is as shown above—nearly 100 per cent. greater mileage per 1-16.

In summing up the foregoing extracts from the reports, your committee is of the opinion that the locomotive engineer has a great deal to do with the wear of the tires on a locomotive by a judicious manipulation of the sand, by exercising proper care in starting, and by avoiding slipping at all times wear must be greatly lessened. We find in talking with engineers generally, their answer is that a careful engineer can, by the use of proper care, greatly reduce the slip of drivers.

On the third question, "What is your method of determining the wear of tire," all, with but two exceptions, report as taking the loss by measuring the diameter of the tire before and after. One takes the record by taking a plaster paris cast of the face of the tire. Another takes it by an indicator and a card, which can be done when desired. Your committee is of the opinion that if the condition or wear of tires could be taken at least once in three months, the party in charge of machinery would be better prepared to present methods of controlling the bad performance in the wear of tires, thus not only giving a correct record of the wear, but lessening the same and adding to the life of the machinery generally.

From the answers received on the fourth question, "Do you have regular engineers on your locomotives?" it appears that the practice of having regular engineers seems to be general. Your committee is of the opinion that it is much more economical to have regular engineers on engines, and that a saving of at least 10 to 20 per cent. is shown in the wear of tires, and it must necessarily follow that the same saving is shown in other parts of the machinery. Your committee is of the opinion that when it is necessary to use more than one crew on an engine, two crews should be assigned to each engine and held responsible for the same, allowing the crews to alternate. The best results are shown by having crews assigned in this way.

On the fifth question, "Will tires run longer between turnings with regular engineers than with different engineers?" your committee is of the opinion that it is much more desirable to have regalar crews on engines. When so assigned, and made responsible for the proper working and condition, they become familiar with the peculiarities of the engine, and will strive to overcome them. No doubt, if everything were equal, the same results would follow—whether with regular or different engineers—but it is impossible to have everything equal and change the crews.

As to the sixth question, "Is a free use of sand desirable or not, etc.," your committee does not consider a free use of sand desirable, as it has a most injurious effect on the wear of tires and rails, as well as increasing the frictional resistance of the train. Of the two evils, sand or slipping, we are of the opinion that slipping is the greater. Therefore use sand judiciously to prevent slipping; use the throttle with judgment; by so doing a greater mileage per $\frac{1}{16}$ inch loss of tire will be shown, and a very much longer life given to the machinery throughout.

We desire to call your attention to that part of the report which refers to the performance of the two mogul engines, where a saving of nearly 100 per cent. is shown in the wear of tires on the engine with regular crew. The report says the difference was caused by an indiscriminate and free use of sand on the engine on which the crews were changed.

JOHN MACKENZIE,
J. S. GRAHAM,
Committee.

It was moved the report be received and the motion was carried.

Mr. Lauder: I hope this subject will not be passed over without a little discussion. It involves a good many questions. The question of economy, of running more than one crew on locomotive; the weight of freight trains; a variety of questions that ought to be discussed. As an illustration of the action of sand on driving wheels and other wheels, I would say, that on the Cape Cod division of our road we only require two-thirds the amount of guaranteed mileage on chilled car wheels than on the other parts of the system. This is due to sand. I mention this to show as a positive proof that sand does have a great influence on the wear.

Mr. Sinclair: I would like to testify to my admiration for the admirable report Mr. Mackenzie has gotten out. I think it is quite a model in that line. Every word in it seems to be important to the subject on hand. I am rather strongly impressed with the influence the engineer has over the wear of tires. I think every man who has watched different engineers pulling trains out of a station where they are hard to start, could not fail to have been impressed with the difference in men. One would make the engine slip persistently, and one would get the engine going with little slip, and it very often happens that the one which made the least slipping would use the least sand. I think the wear of tires is accelerated very much by the free use of sand. In looking into the causes of flattening of wheels by the use of brakes, I find that the men who use sand are those frequently who cause the greater amount of flat wheels.

Mr. Mackenzie: We do not regulate the amount of sand the engineers use, but try to illustrate to them the injurious effect it has upon the engines and rails; particularly in switching engines. The wear on the rails is so very quick that our attention has been brought particularly to that part of the matter. Where an engineer uses an excessive amount of sand, he is allowed to rest for a few days.

Mr. Hickey: I fully agree with reference to the use of sand. Practical experience demonstrates very clearly that the indiscriminate or even moderate use of sand is destructive. Gentlemen yesterday, said traction increasers were of no use. They also spoke against the sand. Now what are we to do? We can not load our locomotives down, to meet the most imperfect conditions of rail? We proposed yesterday to continue a committee and add two more names, and investigate the traction increaser, and it was voted down. The traction increaser and the use of sand are very nearly related. This matter should be taken up again. We should not go on record as we have done.

Discussion closed.

Englishmen Discussing Canadian Locomotives.

At the last meeting of the Institution of Mechanical Engineers, held in London, a paper was read by Mr. Francis R. F. Brown, mechanical superintendent of the Canadian Pacific Railway, on Construction of Canadian Locomotives, which excited great interest and elicited a most lively discussion.

The engines described in the paper are Class S A, eight-wheel engines, with cylinders 17 × 24 inches, and driving wheels 62 inches diameter; Class S C of similar type, but with driving wheels 69 inches diameter; Class S B, heavy eight-wheel passenger engines, with cylinders 19 × 22 inches, driving wheels 69 inches diameter, and weighing 95,800 lbs.; Class S D, the light consolidation illustrated in the May number of the NATIONAL CAR AND LOCOMOTIVE BUILDER, and Class S G moguls with cylinders 19 × 24 inches.

In designing and building all the engines described in the paper, Mr. Brown had followed closely after American types, although his personal mechanical ability and fertility as an inventor are displayed in the admirable way many of the details are worked out, and in the adaptions made for the special service some of the engines are engaged in. Great attention has been devoted to making parts interchangeable for all the classes of engines, and every care has been bestowed upon making the necessary running repairs as easily effected as possible.

RELATIVE COST OF CANADIAN AND ENGLISH LOCOMOTIVES.

After describing minutely the construction of the various classes of locomotives which are familtar to our readers, Mr. Brown's paper continues: A batch of five engines of the S A class which the writer has recently completed cost, without extras, $5,205 each, or about £1,071; or 2.44 pence per lb. for the finished engine and tender. The cost of an English engine, built in the shops of the London, Brighton & South Coast Railway, has recently been given by Mr. Stroudley at 5.57 pence per lb. The cost here given by the writer, being less than half that of the English engine, may be regarded with some surprise; and a few leading details will therefore be added. This cost includes all the coal used in the forge; blacksmith's, boiler and other shops, as well as all small tools and supplies used in the construction of the engine, such as brooms, brushes, candles, chisels, files, hammers, handles for tools, hemp, oil, waste, sand paper, tallow, wrenches, etc.; and also a complete set of tools of all sorts, lamps, oil cans, jacks, dogs and wedges, fire-irons, etc., for the equipment of the engine in running order. But it does not include the salaries of foremen, draughtsmen and clerks; repairs to machinery; maintenance of buildings; water or coal used in the stationary boilers required for running the shop engine. These are not included, for the reason that on some railways such expenses are charged in a lump sum, varying from 5 to 15 per cent., which is added to the cost of the finished engine. In the main shops of the Canadian Pacific Railway these expenses are about 5 per cent.; but in order to put these shops on such a basis as will compare with any other establishment, it is the practice to add 15 per cent. to the cost of both labor and material of the manufactured goods. Hence, by omitting this charge altogether in the cost above given, a comparison can be more easily made according to the varying practice of other railway shops and manufactories.

Detailed Costs.—With regard to the detailed cost of certain portions of finished work for these engines, the

forged frames cost 2 pence per pound, including scrap (charged out at market value) and all coal; when planed, drilled and slotted all ready for erecting, the frames cost 2½ pence per pound. The finished boiler ready to go into the frames costs 4 pence per pound, the steel plates having to be imported from Scotland, and freight and duty paid. The total cost of cylinders, fitted with covers, studded, and ready for erecting, is 2½ pence per pound; and as the shops do not include a foundry, 2 pence per pound has to be paid for the cylinder castings. The cast-iron driving-wheel centres cost 1¼ penny per pound, including cost of freight for over 400 miles. Connecting-rods and side-rods, fitted up with brasses, cotters, etc., all ready for use, cost 7¼ pence per pound.

DISCUSSION.

Mr. T. W. Worsdell opened the discussion. He objected to the wide spread of cylinders in the engines, and believed the author had gone back to former American practice in some respects. The speaker disliked the wagon top boiler, and said it was not much different from an English type abandoned twenty years ago. He had used steel fire-boxes successfully when he was on the Pennsylvania Railroad, but the feed water was very soft. Thought it would be interesting to know if steel fire-boxes were found satisfactory where the water was bad. In relation to the low cost of the engines, he thought it was brought about by using iron tubes instead of brass, steel fire-boxes instead of copper, and other parts of the engine of cast iron instead of brass, weight being of little consequence on American lines. Where the English use largely steel and wrought iron forgings, the Americans use heavy castings. He was inclined to think that the very best material, however expensive it might be for manual labor, was the cheapest in the end.

Mr. S. W. Johnson, taking up the cost of the Canadian engine at £1,071, or 2.44d. per pound for finished engine and tender, said that a Midland goods engine would cost £1,677, or 3.3d per pound, the higher cost of the English engine being due to the use of more expensive material. Considered that tires fastened by their own shrinkage alone could not be safe.

Mr. R. H. Burnett regarded the engines described as abreast of American practice. It was not to be assumed that Canadian or American practice was in any way in advance of English practice, because engines in this country might not be suitable for the rough roads peculiar to America. There was not a single detail that showed anything in advance of the best English practice to be met with in the Australian colonies. Asserted that English-built engines worked satisfactorily on reverse curves of 8 chains radius on inclines of 1 in 40. This was much more trying than anything required by the Canadian Pacific locomotives, where the maximum gradient was 1 in 100, and the sharpest curve 14 chains. Objected strongly to the "old fashioned and obsolete" bar frame used on the engines. With respect to steel fire-boxes, he said it was a question depending entirely on the character of the water used. Steel would answer where the water was soft, but where not good copper gave better results. About cast iron wheel centers, they answered no doubt for diameters not exceeding 4 feet and for low speeds, but for larger sizes and higher speeds wrought iron centers were not only lighter, but being more elastic, they caused the tires to suffer less. Mentioned the failure of cast iron wheels of some American engines in New South Wales, also raised the objection that the bosses of cast iron wheels wore by rubbing against the axle box. Thought the American bogie inferior in workmanship and less substantial than English bogies. Preferred the English practice of turning the driving axle larger for the wheel than the rest of the axle. Thought the axle boxes and axle forks of American engines were less durable than those of English make. Objected to the practice of mounting tenders and bogies, and said it did not give the means of applying so powerful brakes as the English design of six-wheel tenders gave. The standard locomotives on the New South Wales railways corresponded closely in many features to the Canadian engines, but were more substantial and powerful. Preferred the New South Wales engines (his own modified design) and considered that English engineers were not behind Canadian or American engineers in adapting themselves to the particular conditions under which they were required to work.

Mr. David Joy considered American locomotives well adapted for the roads they ran upon. It was a question if some of the features of the American engine could not be adopted with some advantage in the English engine.

Mr. James Holden said that steel fire-boxes had been tried several times on the Great Western with unsatisfactory results. He had good engines running with cast iron wheels 62 inches diameter, but the tires were secured by Mansell fastenings. Had tried Mogul locomotives, but they were more expensive for fuel and repairs than English engines.

Mr. David Greig considered the English locomotive nearly perfect for English lines, but for inferior road-bed thought the American type of locomotive much better adapted than any English locomotive that had yet been made. Considered that English manufacturers were losing their position through not following the lead of those who were their pioneers in matters of this kind. Advised every locomotive maker to study the paper carefully. Was particularly impressed with the simplicity of the American engine, with its cheapness and with the remarkable ease with which its parts could be replaced. Once bought ten tons of old discarded American wheels and brought them to his foundry and asked the men to cast them into cylinders, but they could not break them. Thought English makers would find a better cheap wheel in cast steel.

Mr. Druitt Halpin had seen only one American locomotive which was at the Paris Exhibition, and in design, workmanship and material it left a great deal to be desired. The frame was the old discarded Bury frame, to which he raised a great many objections. He could see no merit, but many objections to the wagon-top boiler; the general design of the boiler was adversely criticised, and, in fact, every thing about the various engines described was attacked except the size of the steam pipes.

This concluded the first portion of the discussion.

MR. BROWN REPLIES TO THE CRITICISMS.

Mr. Brown has very kindly supplied us with a copy of the reply he has sent to the criticisms of his engines, which we find to be exceedingly interesting reading. Our limited space prevents us from publishing much of the reply at present, but we give the greatest portion of the answers to Messrs. Worsdell and Burnett, and we will return to the subject in future issues.

In the course of his reply to Mr. Worsdell Mr. Brown says:

The speaker's remarks on the wagon top boiler are rather misleading. It differs from the old English plan not so much in form as in strength and cheapness of construction, while it presents many advantages discussed in the paper. With regard to flanging, the author would explain that his practice is to use fully formed flanging blocks, and as far as possible to flange at one heat, the plates being heated in a furnace capable of holding the largest sheet to be flanged for any of his classes of locomotives, and he will add that his contract price for the complete flanging of a set of plates for an S A boiler is £9, which result could hardly be obtained if the flanging was done by a small piece at a time, as described by the speaker.

With regard to the use of mild steel for fire-boxes, and the question "whether on lines where the water was bad the use of this mild steel was satisfactory," the author unhesitatingly states that it is satisfactory, and on some lines in the Western States using water containing an average of thirty grains of lime to the American gallon he is informed that steel stands better than any other material.

Some nine years ago the author, who was then on the Grand Trunk Railway, tried some copper half side sheets to repair inside fire-boxes, and found they did not last so long as steel, the sharp blast cutting them away rapidly. Later, on the same railway, in 1879, a copper fire-box was put in for trial, the result being unsatisfactory for the same reasons as given above; as the material cost about six times the price of steel, the author considered further trials only a waste of his company's money.

With respect to steam domes and their position, the speaker will admit that whether it is advisable or not to put them over the point of most violent ebullition, it is certainly advisable to put them where no priming is found to occur, and whereas other roads in Canada have experienced great trouble from priming with level top boilers and domes on the barrel, the Canadian Pacific Railway engines are remarkably free from it.

Regarding the alleged waste of fuel in the American engine. It is not necessarily the most efficient "engine" that evaporates the largest quantity of water, though these remarks may apply to a boiler. Neither is it any measure of efficiency to compare the weight of fuel consumed per mile, regardless of quality, cost, state of track or weight of train. The only true basis of comparison is the cost of hauling *one ton one mile* under given conditions, and Mr. J. S. Jeans, in his work on railway statistics, quotes from Mr. Dorsey's paper, read before the American Society of Civil Engineers, figures showing so far as they can be compiled, that the American engine is far the more economical machine when considered as a motive power, but not from an ornamental point of view.

The author did not give any cause to infer that because the preference is given to keep trains in motion, that the question of economy of fuel is disregarded. It is far from being so, but it is necessarily given the second place.

Replying to Mr. Burnett, Mr. Brown says:

Mr. Burnett's remarks as to the curvature to be provided for show that he has most probably not noted that the author expressly stated that the 6° limit did not apply to mountain sections where curves of 10° occur, corresponding very nearly with the 8 chains radius cited by the speaker, but occurring in steeper grades than 1 in 40, and are passed round equally readily and worked every day where required without any rivets or bolts being sheared off, as happens to the English type of locomotive described by Mr. Greig. Is the author to infer that curves of 8 chains radius and grades of 1 in 40 to 1 in 30 are common in N. S. Wales? Also the author would be interested to know the type and dimensions of wheel base of engines which performed this service before Mr. Burnett found it advisable to imitate American practice by conversion of the Mogul type at the later date of 1881. Again, what did the conversion cost, and what percentage was that of the cost of an equally efficient new American or Canadian Mogul of equal power? The author finds it interesting to notice that the speaker found it to his advantage six years ago to follow American practice under such circumstances.

Again, if the English system of wheel base were perfect for all conditions, why has the American four-wheeled truck gained such headway for fast express engines, even on the perfect English track, where the lines are old and not the later extensions quoted by the speaker?

Is the author to understand that the Australian practice has some features in advance of that of England other than that copied from American practice?

As to the "old-fashioned bar frame, now obselete," the author would call the speaker's attention to the fact that there are about 28,000 bar-frame engines in the United States and Canada alone, or nearly twice the number of plate-frame locomotives running in the United Kingdom, as reported by Mr. J. S. Jeans in his recent work; besides, locomotives with bar frames are exported to South America, Australia, etc., where the demand is growing—which facts prove the speaker's mere statement totally incorrect.

The speaker considers the bar frame a mistake in the narrowness of the fire-box, on account of the diminished grate area, and the author is just as much puzzled by the retention of the crank axle in England, which, by shortening the fire-box, decreases the grate area to a similar extent.

The author begs to differ with the speaker that the elasticity of the wrought iron driving wheel causes the tires to suffer less, as the opposite is the truth, in his opinion. The light rims of the English wheels do not support the tires between the spokes, and the spokes also deflect so that the elasticity commended appears to be the very cause of the trouble that English engineers experience, and the expense they go to to find a suitable fastening for the tire. Cast steel is better in that it has more stiffness, and would probably be still better if the forms which were suitable for forgings were discarded and the stiffer forms which castings admit of were adopted; but from an economical point of view maintenance included the cast iron wheel is incomparably better for Canadian requirements.

The speaker admits some saving in first cost of axles due to their form in American engines, but he omits the equally great saving in maintenance. The author would also call his attention to the fact that when the axles are of steel, which is usual at present, the absence of any change in size adds largely to the life of the axle, failure of the class described by the speaker, *i. e.*, inside the wheel, being an extreme rarity, which can not be said of English engines, even though the corners are filletted to a large radius. This is probably accounted for by the leverage, equal to the radius of the fillet which the weight on the wheel has tending to break the axle, since the box can not be made to bear on the fillet, or it would run hot at once, whereas in the Amerioan axle the weight has only a leverage equal to the slackness of the box sideways, which is but a fraction of the former. A further very important disadvantage of the English form of journal, with rounded corners, is that the actual bearing surface is diminished by the amount of the two curves; that is, an American axle with a journal 8 in. long has as much efficient bearing surface as an English axle with a journal 10 in. long, the consequence being that with journals of equal length the American engine does 25 per cent. more service before the boxes need any attention. Of course the inside fillet could not be dispensed with for crank axles, but the outside one might in all cases, thus adding 12 per cent. to the bearing surface, and therefore diminishing the repairs.

The author has again occasion to refer the speaker to the kind of track when calling attention to the durability of axle boxes and forks. Though wedges are used in all Canadian engines they can not always be kept in the closest position, some allowance having to be made to allow the engine to rock and to rise and fall without the boxes getting fast in the horns, and this slackness, though small, necessarily diminishes the life to some extent. The author would like to ask Mr. Burnett how, if the American engine can not "be relied upon not to break down by the way" they have ever succeeded in working the "boundless prairie," where a repair shop is not to hand every few miles, nor even a stick of wood to block the cross-head and get along "with one leg." The author has occasion to be of the opinion that even under the adverse circumstances, the English engine can not approach the American one for cheapness in maintenance and repairs, though the speaker *assumes* the opposite.

The materials of the engines quoted by the speaker as being of English manufacture all had freight and duty paid on them, which tells against the price of engines built by the author, so that it appears that any but the whole locomotive can be obtained in England at a low figure.

The speaker's comments on wheel base and brakes of tenders are manifestly incorrect. The double truck tender does not need the wheel flanges cut away to make it possible to pass round any curve found advisable, neither are the wheel flanges cut by the rails, which close inspection would show on the long fixed base of the six-wheeled tender. As to the brakes, the author would ask if the speaker applies any brake more powerful than

the Westinghouse Automatic Air Brake which it is usual to apply to the wheels of the double truck tender; and if so does he calculate on skidding the wheels when the tender is empty?

The standard passenger engines of New South Wales approach so nearly in main features to the American practice that the speaker can scarcely claim any merit in them apart from those. They even copy the defect of being over-cylindered to some extent (unless the boiler pressure is very low), which defect is gradually being corrected in modern American practice. The Moguls also could not really utilize more than 130 lbs. boiler pressure. It is hardly fair as a comparison for Mr. Burnett to advance a hybrid copy of an American engine, and pose it as being a type of English engine.

Steam and Motive Power.

BY ANGUS SINCLAIR.

(*Continued from page* 77.)

ADVANTAGES OF USING HIGH PRESSURE STEAM.

The degree of pressure at which steam is admitted into the cylinder of a steam engine exercises a direct and important bearing upon the economical working of the engine. American engineers have always been noted for employing high tension steam, and this feature of our engineering practice has done much to develop the peculiarities of the American type of steam engine. When Watt and his contemporaries in Britain were operating their ponderous engines with pressures seldom more than ten pounds above the atmosphere, Oliver Evans and other early American engineers were using steam of 100 pounds pressure and upwards to the square inch. As a result the small non-condensing engines developed certain powers with one-tenth of the weight of machinery used abroad, and compared favorably in point of economy with the elaborate and expensive engines that found favor and patronage in other countries. The force of numbers in following a bad example led many of our engineers to adopt the Euro-pean practice of low steam pressure, but it was a move in the wrong direction which all those interested had to pay for.

Those who have been able to note the rise in steam pressures from about two atmospheres or under to ten or eleven atmospheres as common working pressures, are well aware that the change has effected enormous saving in fuel. When ten pounds above the atmosphere was the steam pressure ordinarily employed, each horse-power developed by the engine would require the consumption of 15 pounds or more of good coal per hour. Work was done so expensively under these conditions that the use of steam in transportation was seriously curtailed. Had no material change taken place, millions of acres of land in the States remote from the seaboard, that are now producing wheat and corn, and give comfortable homes to prosperous settlers, must have remained a wilderness, for the cost of transportation would have rendered the produce of no value to the producer. Increase of steam pressure, combined with other mechanical improvements, has changed all this. The plain slide-valve engines employing steam of 100 pounds gauge pressure now used in many factories, do their work with a coal consumption of about 5 pounds per horse-power per hour. Superior types of engines will produce much better results. A considerable share of this saving is due to improvement in mechanism, but the greater proportion results from the use of high pressure steam.

Using steam of high pressure is economical for several reasons.

In the first place, steam of high pressure admits of a wide range of expansion. Examples have already been given of the increase of work that may be obtained from a given volume of steam by using it expansively. Every pound of increased tension augments the value of the steam as a medium of doing work, and one of the most urgent themes among officers responsible for the economical operation of railroads is that of having the potential power of the high pressure steam confined by the strong boilers converted into the work of turning a locomotive's driving wheels, instead of being reduced and its force wasted by passing through a restricted throttle opening. The quantity of heat expended in raising steam to a tension of 150 pounds is very little more than that required to evaporate the water at atmospheric pressure, yet the high tension makes a wonderful addition to the capacity of steam for doing work in an ordinary cylinder. As has already been explained, it takes 1,146 heat units to convert one pound of water into steam at atmospheric pressure. The expenditure of 47 more heat units raises the steam to a pressure of 150 pounds. Heat is the source from which all the power of steam is derived, and if the steam engine was a perfect means of converting heat into work, the small quantity of heat employed to raise the tension of steam from gauge zero to 150 pounds would be proportionally of the same value as the heat first applied to the water. But with the imperfect steam engine at the service of the industrial world, the first 1,146 heat units would practically be worthless for motive power purposes, at least with non-condensing engines. The heat units added to make up a good working pressure of steam constitute the active element in the boiler, and provide the means of converting heat into work.

A second advantage gained by using steam of high pressure is, that the proportion of the heat expended in overcoming external resistance, is small compared to the total heat units expended.

A third advantage is that the proportion of back pressure in the cylinder that uses high pressed steam is smaller than is practicable with a cylinder using low pressure steam. There is always more or less steam in the cylinder that fails to escape when the exhaust port is opened and it obstructs the piston during the return stroke. The amount of back pressure is not materially affected by the initial pressure of steam. With high initial pressure the obstruction of back pressure is not likely to seriously affect the efficiency of an ordinary engine, but with low initial pressure the case is different, and a large proportion of the work done by the steam on one side of the piston may be expended in expelling the steam on the exhaust side.

DISADVANTAGES OF USING HIGH PRESSURE STEAM.

Although the advantages of using steam of high pressure are manifold, the practice entails a few drawbacks. The temperature of the boiler being high corresponding to the steam tension, the gases of combustion must pass out at a relatively high temperature, carrying away heat that might be retained in a boiler furnishing low pressure steam. The boiler that furnishes steam of high pressure must be stronger and better made than one that is intended for carrying light pressure. There is considerably more friction to the rubbing surfaces of an engine operated with high pressure steam than with that of low pressure. When the steam pressure carried on British locomotives was under 100 pounds, they were run without any cylinder lubrication, and there was very little cutting of rubbing surfaces; but steam of 140 pounds can not be used without the means of oiling valves and pistons. Even with good means of supplying lubricants, there appears to be a high percentage of the power of engines using high pressed steam absorbed in overcoming internal resistances.

LIMITS TO THE ADVANTAGES OF HIGHLY PRESSED STEAM.

There is probably a limit not far beyond the prevailing range of high boiler pressures, where increase of tension will cease to be economical. A superficial knowledge of the laws relating to steam has led some engineers into error respecting the economy that may be obtained by continuing to increase boiler pressures. They reason that increase of steam pressure from 10 to 100 pounds having been productive of the most gratifying results, to raise the working pressures 100 or 200 pounds more must lead to a proportionate saving of coal, the only added outlay being for stronger boilers. Like many other problems in steam engineering, this one would not work out in the way popularly expected. As the tension of steam is increased, the proportion of saving obtained by higher pressures increases slowly. A perfect steam engine is not found at work any more than the cylinder we figured on that produced no condensation or reduction of pressure, but calculations based on the theoretical performance of a perfect steam engine may put the case clearly to our readers, and show why the economical limit of steam pressure may be nearly reached when boilers carry 150 pounds of pressure per square inch. The following table shows the steam per horse-power per hour required in a perfect non-condensing engine at certain gauge pressures:

Gauge pressure.	Pounds steam per I. H. P. per hour.	Gauge pressure.	Pounds steam per I. H. P. per hour.
10	69	90	17
20	41	100	16.25
30	32	125	14.70
40	26	150	13.60
50	23	175	12.80
60	21	200	12.16
70	19	250	11.20
80	18	300	10.48

A critical examination of the figures given, will show that increasing the pressure from 10 to 30 pounds reduced the steam consumption more than one-half, and increasing the pressure from 50 to 100 pounds reduced the consumption of steam 6.75 pounds per horse-power per hour. Increasing the pressure from 100 to 150 pounds did not bring forth such a gratifying result in the way of saving as the others, still the horse-power per hour was obtained with a reduction of 2.65 pounds of steam per horse-power per hour. The next increase of 50 pounds pressure brings only a steam reduction of 1.44 pound, and every succeeding increase of pressure is followed by items of steam saving that grow beautifully less.

No high pressure steam engine obtains the work named out of the quantities of steam mentioned, for no account is there allowed for losses due to condensation, back pressure and other causes, but well designed steam engines properly managed do their work with a saving that closely corresponds to the figures given when increase of initial pressure is introduced.

ECONOMICAL LIMIT OF WORKING STEAM EXPANSIVELY.

The table given of steam used per horse-power per hour for various pressures is worked out on the supposition that the steam is expanded down to atmospheric pressure without loss of energy from liquefaction or other causes. Expansion to this extent and under such conditions is impracticable, and the calculations made on such a basis are useful only as an intelligible means of comparative measurement. But although expansion of steam to the extent given in the table is out of the question, expansion within possible limits is the correct line of economical working. We hear a good deal said occasionally about the most economical point of cut-off and the economical limit of of working steam expansively, but the objections urged against wide ratios of expansion do not apply to locomotive practice. Steam is never expanded too far with locomotives having the link motion and fairly well protected cylinders; and the advice will generally be accepted as sound to make the ratio of expansion as great as possible. There is undoubtedly a limit where expansive steam makes expensive operating, but it is seldom reached in locomotive practice. Taking the ordinary locomotive as having a stroke of 24 inches, the shortest point of cut-off possible with the link motion, to give an opening that will admit steam enough for ordinary work, is 6 inches, or 25 per cent. of the stroke, a proportion that holds good with engines having a shorter or longer stroke. When the cut-off takes place at 6 inches, release will happen at 16 inches, or less, so that the steam is not expanded three times before the valve opens. The expansion will not be more than four to one, reckoned to the end of the stroke when the steam is passing out during part of the time.

This is far short of the economical limit of expansion. The trans-Atlantic steamers that have been operated most economically, use from 7 to 8 expansions with compound engines and steam jacketed cylinders, but many engineers believe that the expansion is far too limited. This would probably be too much for locomotives, but there are data indicating that nothing short of 5 expansions is likely to cause waste of heat unless the cylinders are very badly covered.

HIGH PRESSURE AND SMALL CYLINDERS.

There is another cause not yet adverted to for high pressure steam being more economical than steam of low tension. High pressure steam performs a given measure of work with much less cylinder capacity than what is practicable with steam of low pressure. Increasing the diameter of a cylinder adds rapidly to the extent of rubbing surface which causes loss of useful effect by frictional resistance, and also increases the area that produces condensation of steam. An ordinary locomotive carrying 100 pounds gauge pressure and cutting off at 9 inches, will have an average cylinder pressure of 40 pounds while making 150 revolutions per minute. If the driving wheels are 5 feet diameter, this piston speed will keep the train going about 26 miles per hour, which is a fair average speed. The same locomotive carrying 145 pounds boiler pressure, will average 60 pounds cylinder pressure. An engine with cylinders 16 inches diameter will do as much work with 145 pounds boiler pressure as an engine with cylinders 20 inches diameter can develop while using steam of 100 pounds pressure.

The size of cylinder most commonly used on our locomotives is 17 by 24 inches, and the most common boiler pressure is 130 pounds. An engine of this kind will indicate an average cylinder pressure of 55 pounds while making 150 revolutions per minute. The constant increase of weight of trains and acceleration of speed makes a demand for more powerful locomotives, and the present tendency is towards heavier engines and larger cylinders. The cylinders have been increased in rapid succession from 17 to 18, 19 and 20 inches. It has been demonstrated repeatedly that increase of cylinder, when the higher sizes are reached, has not been attended with a corresponding increase of power. Few master mechanics are satisfied with the performance of large cylinder locomotives, the complaint being heard on all sides that they are not nearly so good for their inches as smaller engines. The cause of this is not far to seek. In the first place, the steam ports of large cylindered engines are seldom proportionally as large as the ports of smaller engines. Then a serious proportion of the added power is lost by friction, and a great portion of the steam is condensed by the increase of cylinder area. An engine with cylinders 19 × 24 inches has over 300 square inches, equal to 19 per cent. more rubbing surface in the cylinders than an engine with cylinders 17 × 24 inches. The increase of area, that acts the part of a condenser to the steam, is considerably greater for the larger cylinders. Rubbing surface in a cylinder induces greater friction and causes much greater internal resistance than any other part of the engine except the slide valve, consequently every effort should be made to reduce this surface to its smallest possible limit.

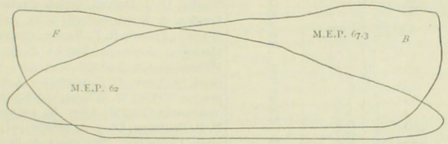
Material increase of boiler pressure ought to be resorted to as a means of obtaining increase of power without making the cylinders larger. This convenient means of increasing power is too seldom resorted to, and in most instances where pressures have been raised above the common practice, it has not been done with a view of keeping down the cylinder area. A master mechanic has a type of engine with cylinders 17 × 24 inches and wheels 60 inches diameter, the boiler carrying steam of 130 pounds pressure. This engine at starting in full gear develops 13,500 pounds traction, and in running at 26 miles an hour, cutting off at 9 inches, the tractive force is 6,358 pounds. The engines are not handling the trains satisfactorily, and new ones are ordered with cylinders 18 inches diameter, the other dimensions being the same except that the boiler is larger. When these engines go into service they are reputed to be little or no better than the old ones, and

everybody is surprised. Now, if the boiler pressure had been increased 15 pounds and the old size of cylinders retained, the engines would have developed as much power, at the same time having 152 square inches less cylinder area. By increasing the boiler tension to 160 pounds, the old size of cylinders would have developed power equal to that of a pair of cylinders 19 × 24 using the lower working pressure. The engine with the small cylinders and high boiler pressure would not indicate so much power when linked close up, but the internal frictional resistances would be so much less and other sources of waste would be so much reduced that the engine could be depended upon to do much more work with less expenditure of steam.

Braking Effect of Cylinder Counter Pressure.

It is a fact well known to engineers familiar with the operating of locomotives that under certain circumstances advancing the reverse lever a notch or more when the engine is running will not result in increasing the speed, and that in some cases it will cause reduction of speed. For instance, an engine working in the 9-in. notch is making 300 revolutions per minute and pulling the train 55 miles an hour. The engineer wishing to increase the speed still further, drops the lever to the 12-in. notch and finds that instead of running faster the train begins to lose speed. Some of our most intelligent mechanical engineers have been puzzled to clearly account for this reputed action of locomotives, and the annexed diagrams are given as an interesting explanation of the phenomenon, although they were not taken from a very high speed engine.

The diagrams are from engine No. 44 of the Central Iowa, and were taken when the locomotive was pulling a fast freight train. There is a prevailing inclination among the engineers of this road to run their engines throttled, the reason alleged in this instance being that throttling



the steam saves water. My intention was to illustrate by the indicator that more steam was used when the throttle was partly closed and the steam permitted to follow the piston a considerable portion of the stroke than there was used when the throttle was kept wide open and the engine worked with the reverse lever hooked back as far as possible. The engine was making 210 revolutions per minute, which represented a train speed of 36 miles an hour when the diagrams were taken. The throttle was only about ¼ open and the reverse lever was in the 15-inch notch when diagram F was taken. My intention, as soon as this forward end card was taken, was to have the engineer pull the reverse lever back to the 12-inch notch and open the throttle wide, so that I could show the different effect of the steam in card B, which represents the back end of the cylinder. The engineer misunderstood the order, however, and dropped forward one notch instead of pulling it back, thus admitting steam for 18 inches of the stroke and greatly increasing the back pressure, as will be observed.

When the first diagram was taken, the engine was admitting too much steam into the cylinders for the piston speed and the means provided for exhausting steam quickly from the cylinders. If steam had been admitted into the cylinders at a higher pressure, the same amount of work could have been done with an earlier cut off and an earlier release. The effect of the latter change, which accompanies an earlier cut-off with the link motion, would have been to give the steam longer time to escape before the beginning of the return stroke. Dropping the lever forward a notch exaggerated the evil from which the engine was suffering when card F was taken and materially increased the back pressure which the piston had to work against during the return stroke.

In card F the mean effective cylinder pressure is 62 pounds to the square inch, and the counter pressure is 16.5 pounds to the square inch. If the engine was worked entirely without back pressure, the efficiency of the steam might be called 1. Working against the back pressure named, the efficiency of the engine is:

$$\frac{62 - 16.5}{62} = .73.$$

In card B the mean effective cylinder pressure is 67.3 pounds, and the back pressure averages 25 pounds. The efficiency of the engine working under these conditions is then

$$\frac{67.3 - 25}{67.3} = .63.$$

Considerably more steam is used with the engine working as shown in card B than in card F, yet so much work is done forcing the steam out of the cylinder that less power is available for moving the train, and if the reverse lever had been kept for any length of time in the 18-inch notch, the speed would have diminished.

The boiler pressure was 135 pounds. Indicator spring, 80 pounds scale. A. S.

Safe Heating of Cars.

During the recent convention of the Master Mechanics' Association at St. Paul, Minn., a considerable number of members visited, by invitation, the car shops of the Northern Pacific Railroad at Como. These shops are of recent construction, and were fully described in the National Car and Locomotive Builder for April, 1886, with an illustrative diagram. In their design and machinery equipment they embody all the improvements which present experience can suggest. The visitors were received and conducted through the shops by Mr. J. C. Barber, the master car-builder in charge, and the various objects of interest carefully inspected. The train which conveyed the visiting party to Como consisted of three cars drawn by a "Strong" locomotive, "Duplex 444," which had just arrived from the East for inspection by the members of the association.

Two of the cars were furnished with the device of the Safety Car Heating & Lighting Co., of New York, the design of which is to use steam from the locomotive for heating cars, in connection with the existing hot water and hot air systems without material change. The working of the device was under the direction of the inventor, Mr. F. M. Wilder, who is the general manager of the company, and was formerly superintendent of motive power of the New York, Lake Erie & Western road. With the water-circulating systems, connections are made to the hot and cold pipes of those systems brought down to a drum or cylinder underneath the car, which contains a bench radiator provided with a trap, and as heat is conveyed to the water the condensation of the steam is trapped off. In the hot air circulating system, connection is made with the present air pipes within the cars, the air being passed down through and around the bench radiator within a box, and after being warmed is conveyed into the regular circulating pipes within the cars, the same method of conducting the steam through the train and from car to car being used in both cases. The steam for these different radiators is controlled by a valve which may be operated by hand, or by an electro-thermostatic regulator, which will control the heat in the car automatically.

In the cars exhibited there were Baker heaters, and the water circulating system was, of course, used. The train pipe and couplings, which are metallic, were not covered with lagging, as they will be in actual service, and so could be thoroughly examined. On the return trip the steam was turned on and the pipes began to radiate heat in the cars in a short time. The day was raw and cold and the heat was not unpleasant. The couplings are above the platform and just under the railings and the coupling or uncoupling may be easily effected while the train is in motion.

The general idea of this system of heating, retaining in the cars the old heaters which can be used in cases of emergency, seemed to strike most of those present very favorably. Colder weather is, of course, necessary for a complete demonstration of what it will do.

Why the Joy Valve Gear is not in Favor on American Railroads.

A correspondent discussing locomotive subjects in an English contemporary recently, charges American railroad engineers with being conservative and non-progressive, because they have displayed no intention to adopt the Joy valve gear after English engineers have, in many instances, adopted it. "This offers," the writer says, "an instance of the readiness of English engineers to adopt new ideas, and although several engineers have gone back to the old gear, they did not scruple to make important alterations in their designs to suit the new gear. On the other hand, the Joy gear might be applied to existing American engines without any important changes in construction, and with the advantage of dispensing with the rocking-shaft."

Writers in British journals nearly always display childishly blank ignorance of American mechanical matters, and the correspondent writing about our locomotive men shunning the Joy gear is no exception to the rule. American locomotive designers did not refuse to apply the Joy gear because they disliked leaving the beaten track of the link, but because it was demonstrated that the gear gave no advantage over the link in simplicity of mechanicism or in the distribution of steam. There is a decided difference between trying a device because it is a novelty and trying it because it offers mechanical advantages. American railroad men are intensely conservative about taking up a device for novelty's sake, and they very seldom have to abandon a device introduced to any extent upon a road, for the reason that appliances are, as a rule, thoroughly investigated before being adopted. The Joy motion would not successfully pass the ordeal of searching investigation, and that is the reason it is not a standard appliance on any American railroad. Several of our leading roads equipped a few of their engines with the Joy gear, so that its performance alongside of the link could be fairly judged, and in every instance it was found wanting. The mechanism was harder to maintain than the link motion, the distribution of steam was more irregular, and it did not increase the mean effective pressure for a given point of cut-off. Under these circumstance there was no reason why the link motion should be displaced by the Joy gear.

Master Car-Builders' Association.

REPORT OF COMMITTEE ON STANDARD SIZES OF LUMBER FOR FREIGHT CARS.

To the Master Car-Builders' Association:

In recommending a few standard sizes of lumber for the principal members of freight car frames, the committee does not expect to change existing dimensions on many of the larger roads. Its principal object is to present to the railroad public a bill of material which this Association can recommend to new roads having no adopted standard, and to other roads which are about to change from 30,000 or 40,000 pounds capacity to a car of larger capacity. It is the hope of the committee, therefore, that the larger roads having standard sizes which they do not intend to change, will not oppose a measure which will do them no harm in the matter of car interchange, and may do others much good. The principal advantage which railroad companies would derive from uniform sizes of car lumber is the use of dry, seasoned lumber on contract cars.

By far the largest number of freight cars are now built by contract in the individual shops. What cars are built by the railroad companies in their own shops the lumber is taken from their own yard, where the standard sizes may be kept on hand several years, and when used it is thoroughly seasoned. With the present diversity of sizes for the frames of cars for the different roads, it is almost impossible for the contract shops to keep in stock such a variety of lumber as will suit any order they may get. The result is that in most cases the lumber is not bought until the order is secured for cars, and it frequently happens that it is not *sawed* until that time. It is not an uncommon practice to build cars from lumber which a month before was in the mill pond in the form of logs. The evil effect of this practice is well known to car-builders, and it is undoubtedly the worst feature of contract cars. As the lumber dries and shrinks in the car the whole frame becomes loose, and the life of the car is materially reduced, not only by the working of loose joints, but by the premature decay of the lumber itself, when it is put together and painted before it is dry. It is a well-known fact also that kiln dried lumber is not as strong as seasoned lumber, and it will rot quicker. If standard sizes were adopted the contract shops could keep on hand a sufficient stock of lumber to allow it to season one or two years, and the railroads could then obtain by contract a much better car than they usually do.

It is possible to specify a certain maximum amount of moisture in car lumber, and to obtain lumber to such specification, by measuring the amount of moisture in sample borings. The borings from about a cubic foot of wood are placed in a vial and weighed on a chemist's balance; they are then evaporated to dryness and weighed again. The per cent. of loss noted represents the water driven off. In this way the fluctuation of moisture during the process of seasoning has been obtained for oak, ash and pine, and it is shown in the diagram which accompanies this report.

Green oak, as received in the yard, contains 45 to 50 per cent. water, and after a year's seasoning it still contains over 30 per cent. Norway pine, from the mills, contains over 25 per cent. water, and a year's seasoning reduces it to 10 or 12 per cent. Pine should be seasoned at least one year, and oak two years to avoid excessive shrinkage and early decay. The amount of water in lumber may be taken as a direct measure of the length of time it has seasoned.

The majority of cars now building are 34 ft. long, so that one dimension of the long sills may be regarded as settled for the time. New equipment is also largely centering about a capacity of 50,000 lbs., and we recommend sizes suitable for that capacity. These sizes are not extra large for cars of 40,000 lbs. capacity, and they are sufficient for one of 60,000 lbs. The additional strength required for the latter can easily be obtained by the use of a deeper truss made of iron of larger diameter.

We therefore recommend the following bill of lumber for principal members of car body for 34 ft. box, stock and flat cars, capacities 40,000 lbs., 50,000 lbs. and 60,000 lbs.

UNDER FRAME.

Six long sills, 5 × 9 in., finished Norway pine.
Two end sills, 7 × 9 in., finished oak.
Two cross ties, 4 × 9 in., finished oak.
Four draw timbers, 4½ × 7½ in., oak.
Flooring, 1¾ in. thick, 5 to 10 in. wide, Norway pine.

UPPER FRAME.

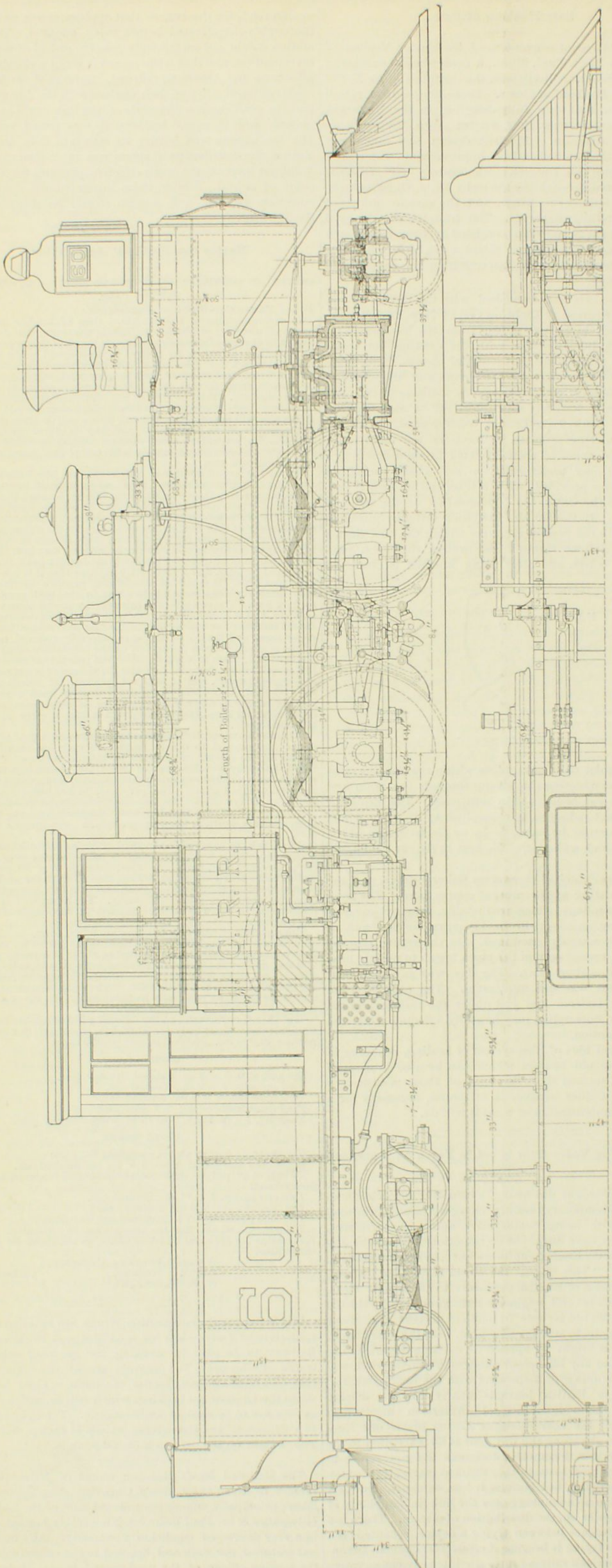
For the same cars as above, excepting flat cars:
Eight door and corner posts, 4 × 4½ in., finished oak.
Twenty-four pieces, intermediate posts and braces, 4 × 3 in., finished oak.
Two end plates, 3 × 12 in., finished oak.
Ten carlines, 1¾ × 9 in., finished oak.
Two side plates, 3 × 7 in., finished Norway pine.

We recommend also that the above sizes be submitted to the Association for approval by letter ballot, as standards for freight car lumber.

William Forsyth, Chairman, }
Frank J. Hecker, } *Committee.*
W. R. Davenport, }

The Schenectady Locomotive Works are building six locomotives of a new class for the Chicago & Northwestern Railway, to be used in working the growing suburban traffic of Chicago. The engines are of the eight-wheel type and have a sloping tender to make a clear lookout when the engines are backing, which will be half the time, as they are to be used as double enders. The cylinders are 18 × 22 inches, and the driving wheels 51 inches diameter. The weight on the drivers is 56,000 pounds.

The Railroad Men's Reading rooms of Milwaukee, a branch of the Young Men's Christian Association that labors principally among the railroad men of the Chicago, Milwaukee & St. Paul Railroad, is miserably housed and is in a very depressed condition financially. Any one who has watched the walk and listened to the conversation of the leading officers of the road named is not likely to be surprised that the subordinates of the company have no use for Christian or moral influences.



SUBURBAN TRAFFIC LOCOMOTIVE—ILLINOIS CENTRAL RAILROAD.

The locomotive shown in the engravings is the style of engine used by the Illinois Central Railroad Company for working their heavy suburban traffic in and around Chicago. We consider this engine the best adapted for fast heavy suburban traffic of any locomotive used for the purpose. The traffic closely resembles that of the Elevated railroads in New York. The stops are at short intervals, and the engines have to force the train quickly into speed to make moderate average running time, which they do very successfully. The engine has cylinders 16 × 22 inches, and the driving wheels are 56½ inches diameter. The total weight is 118,700 pounds, 56,100 pounds being on the drivers, 14,600 pounds on the engine truck and 48,000 pounds on the tender truck. As will be noticed, the whole engine and tender rest on rigid frames, the necessary flexibility being given by swing leading and tender trucks. The engines are run without turning. The first engines of this style used by the Illinois Central Company were built by the Rogers Locomotive Works, and were designed by the late William Hudson. Of late the Illinois Central people have built the engines for themselves in their own shops at Chicago, several improvements having been introduced that are considered valuable.

Popularity of the Master Mechanics' Association.

The American Railway Master Mechanics' Association has always been popular among railroad men; but it appears to be growing in favor, if we are to judge by the number of new members joining and the wide interest taken in the proceedings of the yearly conventions. From all parts of the world requests arrive for the report of the proceedings, and scientific men in Europe, Asia, Africa and Australia appear to be quite familiar with the work done by the association. During this year the following gentlemen have become members: C. T. Johns, Valley Railway; Sidney A. Stephens, Rhode Island Locomotive Works; D. J. Durrell, Union Pacific; Francis W. Webb, London & Northwestern; J. D. Ackley, Indiana, Illinois & Iowa; Francis R. F. Brown, Canadian Pacific; Herbert Hackney, Atchison, Topeka & Santa Fe; Leroy Kells, Pittsburgh, Cincinnati & St. Louis; W. W. Reynolds, Chicago, St. Louis & Pittsburgh; D. T. Everts, N. Y. Locomotive Works; W. Wilson, Chicago & Alton; F. A. Barnes, Wisconsin Central; Lacy R. Johnson, Canadian Pacific; F. P. Boatman, Ohio & Mississippi; W. Garstang, Cleveland, Columbus, Cincinnati & Indianapolis; H. N. Burford, Memphis & Charleston; A. W. Quackenbush, Wabash & Western; C. F. Ward, St. Paul & Duluth; N. L. Kimball, Milwaukee & Northern; G. D. Brook, Chicago & Atlantic; W. Augustus, Keokuk & Western; Peter H. Peck, Chicago & Western Indiana; R. Curtis, Pittsburgh, Cincinnati & St. Louis; T. A. Frazer, Minnesota & Pacific; W. T. Small and C. W. Rossiter, Northern Pacific; G. F. Wilson, Minneapolis & St. Louis; D. McGrayel, Central of Georgia; F. F. Tynan, Bay of Havana; W. S. Morris, Wabash; G. W. Hentzelman, Minneapolis & Northwestern, and S. B. Tinker, Cincinnati, Wabash & Michigan. This makes a total addition of thirty-one good members to the roll.

American Railway Master Mechanics' Association.

175 DEARBORN STREET,
CHICAGO, July 16, 1887.

Below is a list of committees appointed by President Setchel to carry on the work of investigation and other business during the current year. The various committees are urged to begin the work assigned them as early as possible, in order that valuable reports may be prepared in good season for the next convention.

ANGUS SINCLAIR, Secretary.

1. Relative proportions of cylinders and driving wheels to boilers.—Committee: Charles Blackwell, Clem Hackney, J. M. McGrayel.
2. Guides.—Committee: James N. Lauder, W. J. Robinson, H. S. Kolseth.
3. Extension smoke-boxes and brick and other fire-box arches.—Committee: John Hickey, W. A. Foster, E. L. Weisgerber.
4. Springs and equalizers.—Committee: John Mackenzie, J. S. Porter, Wm. Swanston.
5. Tires. Advantage or otherwise of using thick tires.—Committee: J. W. Stokes, C. E. Smart, Henry Schlacks.
6. Purification or softening of feed water.—Committee: Herbert Hackney, John Player, W. T. Small.
7. Prevention of dangerous escape of live coal and sparks from ash pans.—Committee: G. W. Ettenger, E. D. Anderson, W. H. Thomas.
8. Tender trucks.—Committee: E. M. Roberts, H. D. Gordon, H. D. Garrett.
9. Traction increasers in connection with over cylindered engines.—Committee: J. Davis Barnett, F. L. Wanklyn, T. J. Hatswell.
10. The magnetic influence of iron and steel in locomotives on the watches of engine runners.—Committee: James Meehan, Harvey Middleton, T. W. Gentry.
11. Amendment of the Constitution.—Committee: J. D. Barnett, M. N. Forney, A. Pillsbury, J. N. Lauder, Angus Sinclair.

Obituary.—William Woodcock.—Committee: Thomas Millen, C. G. Williams, L. M. Ames.

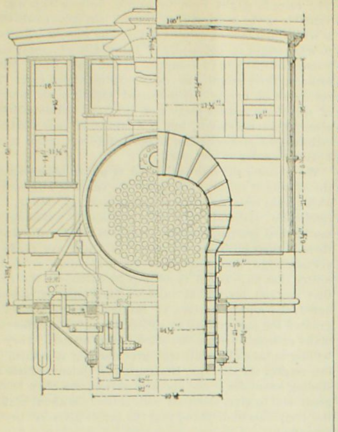
Obituary.—H. G. Brooks.—Committee: M. L. Hinman, Geo. W. Stevens, W. F. Turreff.

Obituary—George Colby.—Committee: A. B. Underhill, O. Stewart, John Thompson.

Obituary—W. W. Evans.—Committee: M. N. Forney, Reuben Wells, E. H. Williams.

Obituary—George E. Howe.—Committee: J. M. Foss, J. T. Gordon, A. Pillsbury.

The Michigan Car Co. is filling an order for 250 box cars for the Flint & Pere Marquette road. These cars, as well as some that are being built at the shops of the road, will be equipped with Marks' couplers. Some 800 cars on this road will then have this style of coupler, and it is said that it will ultimately be placed on the entire freight equipment of the company.



Records of Train Resistances.

For many years formulas have been in use by which the resistance of railroad trains was calculated, but there is good reason for believing that the basis on which many of the calculations have been made is erroneous. The conditions of the parts that go to make up a train are so varied, tracks are so different, and weather is so uncertain, that it is hard to get two trains to offer exactly the same resistance per ton to the pull of the locomotive. It has been found where track is out of order, with frequent low joints and irregular alignment, that the wheels of a train meet with more resistance than they do on a smooth, even track. Car trucks are often defective, and fail to keep the wheels revolving in parallel planes, so that the train resistance is materially increased. There is no defect that continues more common in car construction than trucks out of square, and it is probable that the cutting of flanges, so frequently expatiated upon, is the smallest source of expense arising from this imperfection. There are cars belonging to certain roads that are always noted for being hard to pull, and excessive weight is not the cause. The extra power daily needed in the transportation of such cars would soon pay for renewals or for putting the running gear in proper order.

There is a widespread belief among railroad men and those who have studied the laws of friction, that when the road-bed, the weather and the condition of the cars are equal, the frictional resistance offered by a train of cars will be nearly the same per ton for a given speed. Experiments carried out by the engineers of tests of the Chicago, Burlington & Quincy Railroad by aid of the dynamometer car and other means of obtaining exact and precise records, have demonstrated that the resistance per ton varies materially under different conditions. An examination of the records given below will show that empty cars in nearly every instance offered about twice the resistance per ton that was experienced with loaded cars at the same speed. This is a matter of the greatest importance to those interested in the movement of freight or in the handling of trains, for it indicates that apart from considerations of dead weight the heavier the load the more economically will the freight be transported. The facts that may be gathered from the records ought also to be useful to train masters and superintendents in calculating the proportion of empty to loaded cars that an engine ought to haul, a subject which causes more or less contention upon most roads.

In the first table we give columns of figures which show the method followed of working out the record. The dynamometer car, which is always placed next the engine, has the means of automatically indicating the tension on the draw-bar and the speed of the train. That being known, the profile of the road is taken, and calculations made to show the resistance per ton on a level track. Unless an engineer in charge of work of this character is skilled in estimating the elements that go to form the sum of train resistances, the record will not be of any value, but these tests were conducted by experts who have worked faithfully at the business in the school of experience, and the records are of high scientific value. When a locomotive starts pulling a train even on a level, the tension record is high because a great deal of work is being expended in accelerating the speed, or forcing the train into increasing velocity. When the running speed is reached, and the engine is merely exerting the power required to keep the train in uniform motion, the degree of pull on the draw-bar will indicate the resistance of the train at the speed maintained. One of the greatest difficulties that experts have encountered in estimating the resistance of trains, has been in finding exactly the point where an engine is doing only the work needed to maintain speed. In estimating this by means of indicator diagrams, the mistake has frequently been made of giving a diagram of average work which represented some work due to the acceleration of the train. On the other hand, diagrams have been given that were taken when the engine was losing speed and the apparent train resistance would be inaccurately low. Indicator diagrams alone, used as a means of showing train resistance, are worth nothing unless they are taken by an excellent judge of train speed. In the tests taken by the C., B. & Q. dynamometer car, a fairly accurate means of checking the inaccuracies due to acceleration by the engine's power, acceleration by descending grades, and retardation due to decrease of engine power and to ascending grades, was put on permanent record and was carefully calculated in the tables.

Engine No. 400, with 36 loaded box cars, way car and dynamometer car; total weight of train, 940.9 tons. Run from Aurora to Mendota.

RESISTANCES.

TRACK.	Speed, miles per hour.	Due to grade.	To acceleration of train.	Total.	Pounds per ton for level.
Descent 1.41 in 7,700 feet...	21.4	+ 344	−588	6,000	6.12
" 1.94 in 9,900 " ...	25.7	+ 369	+552	4,450	5.71
Ascent 7 in 9 900 " ..	22.9	−1,331	+570	5,880	5.44
" 11.4 in 12,300 "	18.7	−1.744	−857	8,100	5.84
Descent 4 in 13,000 "	21 8	+ 579	−197	5,260	6.00
Ascent 2 in 8,300 "	20.8	− 450	−915	6,600	5.56
" 3.8 in 6,000 " ...	20.2	- 1,083	−361	6,000	4.84

It will be found that the average resistance of the above train was 5.64 per ton, and the average speed 21.6 miles per hour.

Engine No. 412 took train of loaded cars weighing 1,155 tons, from Mendota to Leland when the undernoted speed and resistance were recorded. Abbreviated table:

Speed	19.7	18.5	21.2	23.1	19.8	21.8	20.5	23.4	19.5
Pounds per ton..	5.34	4.51	3.84	4.97	4.56	5 19	4 51	5 76	5.36

The train resistance in this case was 4.9 pounds per ton, and the average speed 20.6 miles an hour.

Engine No. 74 took a train of 29 empty cars, way car and dynamometer car, the whole weighing 340 tons, from Aurora to Mendota. The average speed was 20 miles an hour and the average resistance per ton was 12 pounds, more than double the resistance per ton of loaded cars.

Speed	19 7	18.8	19.0	19.0	19.0	20.0	15.5	15.7	24.9	29.3
Lbs. per ton	10.3	12.9	12.8	12.2	12.5	12.3	9.6	9.4	13.2	14.5

That the above was not the case of a peculiarly hard pulling train was proved by numerous other records of the resistance of empty car trains, all kinds of freight cars being equally hard to pull.

Engine No. 139, with 20 empty box air brake cars, made the following record. In this case the speed was an average of 24 miles an hour, and the resistance per ton 12.2 pounds.

Speed ...	24 4	25.0	27.0	28.0	29.4	30.5	30 2	15.9	10.1	21.2
Pounds per ton.	14.6	13.1	13.3	13.8	14.8	13.6	12.7	8.8	7.3	10.0

Engine No. 28 took 24 empty coal cars, way car and dynamometer car, from Ottumwa to Streator, the whole weighing 222 tons. The average speed was 24.8 miles per hour, and the train resistance 12.3 pounds per ton, as may be found by figuring out the annexed record:

Speed	22.9	24.6	25.7	24.0	23.4	28.6
Pounds per ton	12.8	14.1	14.0	11.1	11.1	11.2

That the high average speed for freight trains was not the cause alone of the high average resistance, may be seen from the following example. Engine No. 144 took twenty-four loaded cars, way car and dynamometer car, the whole weighing 615.6 tons, at the undernoted speed and resistance. The average speed was 26.6 miles per hour, and the train resistance 6.2 pounds per ton.

Speed	26.4	27.2	28.1	22.0	24.5	29.2	29.1
Pounds per ton	6.5	5.2	6.5	6.3	6.9	6 2	5.6

The following is the record of speed and resistance of a passenger train consisting of 11 coaches and the dynamometer car, the total weight being 362.75 tons. All the tons are reckoned at 2,000 pounds:

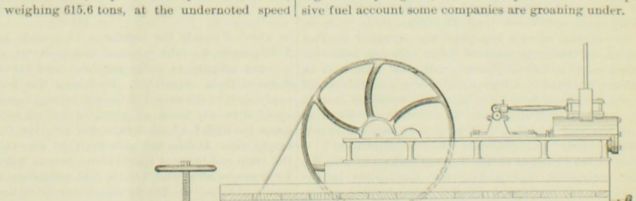
Speed	27.00	30.00	32.10	29.20
Pounds per ton	7.19	7.19	7.93	7.46

The average speed was 29.5 miles per hour, and the average resistance per ton 7.44 pounds.

Proportions of Locomotive Cylinders.

It would be hard to point to any report ever submitted to the Railway Master Mechanics' Association that is of greater importance, or is calculated to be of greater value to railroad companies, than that read at last convention on the Proportion of Locomotive Cylinders. The report itself is a master work of its kind, a great mass of valuable information having been digested and condensed into the smallest possible limits and put into shape convenient for reference or study. The report bears unmistakable evidence of laborious and careful research, the committee evidently having spared no pains to ascertain the practice followed by the best authorities in this country and in Europe in regard to the proportioning of locomotive cylinders in relation to size of driving wheels, weight available for adhesion and steam pressure. American designers of locomotives in years gone by have undoubtedly been in the habit of over-cylindering their engines in proportion to the weight available for adhesion, but the modern American practice, as given in the report, does not differ materially from good modern practice in Europe.

The committee had an exceedingly difficult task to perform in arranging a formula that would give a fairly satisfactory proportion of cylinder for widely different weight on drivers, varied sizes of wheel centers and to meet the diverse practice in regard to boiler pressure, but they worked out the problem with admirable skill and care. The formula is of the character that meets all conditions and works out proportions to agree with best modern practice. Some men may raise the objection that the size of cylinders produced by the rule is too large for the weight on the drivers, but more exception will be taken on the plea that the rule makes the cylinders too small. With objections coming in from two extremes, we believe the committee will receive from the majority the credit of having struck near the happy medium. Their labor amounts to this. The American Railway Master Mechanics' Association, after a searching investigation by an able committee, have decided on the basis of experience, good results in practice and by calculation what are the best proportions of locomotive cylinders in relation to boiler pressure, size of drivers and weight on the same, and the inference is that a designer departing far from the plain rule laid down will produce an expensive and inefficient locomotive. Many master mechanics have to maintain a constant struggle against pressure coming from the operating department requiring the over-cylindering of engines, and the rule laid down will give material assistance to men in this position, and will aid them in their efforts to adhere to sound engineering practice. The fact that adding one inch to the cylinders enabled an engine, when the rail was dry, to take two cars extra over a certain hill, has caused the over cylindering of many engines, and it is responsible for the expensive fuel account some companies are groaning under.



MACHINE FOR ADZING RAILROAD TIES.

The engraving represents a machine for adzing railroad ties. The principle of its construction is very simple. A consolidation narrow gauge locomotive does the propelling, and furnishes the steam for the stationary engine mounted on a frame, as shown. A belt from this engine drives a shaft fastened to an engine frame and mounted on engine truck wheels. At each end of the shaft, which can be raised or lowered at pleasure by a screw, is a cutter-head in which are two inclined adzes and two vertical saws. The shaft revolves about 1,000 times a minute, so that each tie is struck about five times. The speed of the locomotive when working is from 1 to 2½ miles per hour.—J.

The machine was used in widening the gauge of the Utah & Northern Division of the Union Pacific, and did the work so effectively that some $15,000 was saved by it. While in this service, weights were added to the machine of about 2,500 pounds, to give it greater steadiness. To facilitate the stopping of the train, as well as for the use of the men, three cars of air were pulled behind.

The invention originated with Mr. R. Blickensderfer, Superintendent of the Idaho division at Pocatello, and the machine was made under the direction of Mr. J. S. Hickey, the division master mechanic, both of whom will take pleasure in giving their experience in using it to parties who anticipate similar work in the widening of gauge.

NATIONAL CAR LOCOMOTIVE BUILDER

PUBLISHED MONTHLY
BY
R. M. VAN ARSDALE.

MORSE BUILDING .... NEW YORK

JAMES GILLET, } Editors.
ANGUS SINCLAIR, }

AUGUST, 1887.

Subscription.—$1.00 *a year for the United States and Canada; $1.50 a year to Foreign Countries embraced in Universal Postal Union.*

EDITORIAL ANNOUNCEMENTS.

Advertisements.—*Nothing will be inserted in this journal for pay,* EXCEPT IN THE ADVERTISING COLUMNS. *The editorial department will contain our own views and opinions; and the rest of the reading matter, aside from advertisements, will be such as we consider of interest to our readers.*

Contributions.—*Articles relating to railway rolling stock, construction and management, and kindred topics, by those who are practically acquainted with these subjects, are especially desired. Also early notices of changes in railroad officers, organizations and names of companies.*

Special Notice.—*As the* CAR AND LOCOMOTIVE BUILDER *is printed and ready for mailing on the last day of the month, advertisements, correspondence, etc., intended for insertion, must be received not later than the 25th day of each month.*

Difficulties in the Way of Exchanging Ignorance for Knowledge.

We have always been under the impression that the one man rule and "Thou shalt have no other God before me" policy of that one man, had made the Baltimore & Ohio Railroad the most benighted corporation in the United States; but we were hardly prepared to believe the rank and file of the road had fallen into the slough of ignorance lately depicted by one of its leading officers. The road has recently adopted a new policy, and an attempt is making to encourage intelligence and knowledge of the principles of their business among the employés of the company, some of the leading officers having become convinced of the economic value of technical education in railroad operating. A technical school and library have been established at Mount Clare, the mechanical headquarters of the road, and intense disappointment has been expressed because these institutions have not transformed darkness into light in a short season. Dr. W. J. Barnard, assistant to the president, has the educational scheme under his management, and he is evidently very anxious that it shall succeed; but he has met with great discouragement. In the course of a report he says: "There is a commodious library and reading room at Mt. Clare fairly equipped with works of science and industrial mechanics, and where all the important scientific journals are displayed for the especial benefit of our employés, and in the last year, out of 3,000 workmen fewer than 50 visited the library at all, and fewer than 15 utilized these journals. A very careful canvass last year demonstrated the fact that among this great mass of labor only one man subscribed to a technical journal, and *that man was an ordinary mechanic.* A logical deduction from this record is, that our people have little or no knowledge of current improvements or of the results of scientific investigation of mechanical subjects, and as a rule they only know methods crude and generally obsolete elsewhere." A report by the Principal of the School connected with the works intimates that among 500 apprentices in the works not one of them was sufficiently educated to pursue technical studies to advantage. Combined with a lack of elementary knowledge was a lack of inclination on the part of apprentices to make themselves anything more than rule-of-thumb mechanics.

This must be a most discouraging state of things for the officers connected with the property, who have come to realize that knowledge is power, especially in a machine shop, and that the most expensive labor that can possibly be found is ignorant labor. But what else can they expect? They have got the physical and mental accumulation of many years, the kind of material that the policy of the company has produced, and they cannot change its character by issuing a notice that ignorance is no longer popular or in request. It is gross injustice to complain of the apprentices lacking ambition to become anything but common workingmen in an establishment of over 3,000 wookmen, where only one man, an ordinary mechanic, subscribes to a technical journal. The atmosphere of such a place must be stifling with ignorance, prejudice against progress must rule supreme, and the inclination to change from the practices followed in the past would bring scorn and contumely upon the author. A youth must possess strong mental independence indeed to display a disposition to depart from past practices in such an atmosphere, surrounded by the traditions born of ignorance that despise every thing associated with that great bugbear theory. The Mt. Clare workmen and apprentices do not represent the average desire for knowledge respecting the principles relating to their calling that exists among American workmen. The leading workmen in the Baltimore & Ohio shops have always been wedded to rule-of-thumb methods, and they give the tone to each shop, bench and pit, and the influence of leading workmen for good or evil is all powerful. If Dr. Barnard and his associates in the work of reformation are to achieve a positive and permanent success, they must go deeper and do some root and branch tearing up. They may obtain zealous support and hearty co-operation from heads of departments, but the most strenuous efforts on the part of these officers will fail to make the technical school a success, or to render the library and reading rooms popular, so long as a leading man is inclined to cast jibes at the workman who is filling himself up with book learning, or to poke fun barbed with malice at the youngster who is reputed to be in danger of leaving the safe ground of daily practice for the dangerous raft of uncertain theory. The proper cure for this is to turn off all the ignorance-worshiping, non-progressive leading hands, and replace them by men of intelligence from a healthier moral atmosphere, men who understand the needs of the time, and who keep themselves in line with the progress of their calling. When a change of this kind is effected, intelligent and progressive workmen will begin to apply for work in the shops, and a beneficent change will gradually go on. There is no use intimating that technical knowledge is appreciated, and proclaiming that a man who understands the principles of his business is of greater value than the ignorant mechanic, when at the same time the ignorant man is appointed to rule over the men of intelligence. This is a case where theory and practice must harmonize to be successful. Intelligence and mental training increase the value of every man from the humblest laborer to the artist workman, and it is in the shops where the common workmen are most intelligent that work is most accurately and cheaply produced. The officers of the Baltimore & Ohio who are encouraging education are following a good paying lead, but persistent labor will be necessary to develop the mine.

Resistance of Trains.

The record of train resistances, published in another column, are well worthy of the careful study of all officers interested in the transportation of freight and in the movement of trains. It has generally been supposed that the only advantage gained in carrying heavy loads in cars was that the practice made a high ratio of paying load to dead weight. The record referred to, the accuracy of which is unquestionable, proves conclusively that the proportion of axle and wheel resistance is much lower in heavily laden cars than it is in those run empty. The record also shows how little value the accepted formulas of train resistances have, and illustrates the mistakes made by the best known scientific writers when they undertook to explain the extent of train resistance at different speeds and the particulars of the elements which entered into such resistances. In his "Catechism of the Locomotive," Forney adopts the Clark formula for calculating train resistance to American practice, and makes it

$$R = 6 + \frac{v^2}{171}$$

in which R equals the resistance in pounds per ton of 2,000 pounds, 6 = the constant resistance at all speeds, v = the velocity in miles per hour, and 171 a constant deduced from experience. By taking this formula and applying it to the record of train resistances quoted at the speed of twenty miles an hour, its product will be found much too high for loaded cars and two low for trains of empty cars. It does not give even an approximation of the train resistance at speeds above twenty miles an hour, for it ranges away ahead of the real resistance due to increase of velocity. The dynamometer car of the Chicago, Burlington & Quincy has been used a great deal to measure the resistance of ordinary passenger trains, and the record is that these trains, running at 30 miles an hour in ordinary weather, develop as near as possible to 7.5 pounds per ton. The formula makes it 11.2 pounds per ton. The dynamometer car records of train resistance collected by Professor P. H. Dudley agree very closely with those made by the C., B. & Q. engineer of tests. He found that running at 51 miles an hour on the level without acceleration or retardation, the resistance of a passenger train was 11 pounds to the ton. The formula referred to would make the resistance 21 pounds per ton at the speed named.

The records given appear to indicate that passenger cars, loaded freight cars and empty cars all offer different degrees of resistance to the locomotive moving the trains. It would probably be found that the resistance offered by cars belonging to some different road vary as much in their resistance to movement as the different kinds of cars did on this single road. The passenger and freight cars belonging to the C., B. & Q. may, however, be accepted as a fair average of cars, and many railroad officers will find that the peculiarities respecting resistance displayed by them will apply to the cars they are interested in moving. The records ought then to supply data which will be valuable in the making up of trains. On most roads there is wide difference of opinion among the various officers as to what ought to constitute a full train of empty cars. Some roads reckon two empties as one loaded and others estimate three empties as equal to three loaded cars. The resistance of empty cars increased rapidly with increase of speed, the greater portion of it being doubtless due to atmospheric resistance, but it would be an easy matter to estimate the power needed to move different trains up the heaviest grades at low speed.

We consider the railroad world is under obligations to the officers of the C., B. & Q. for the valuable information about train resistance we are thus able to supply. All intelligent railroad men are constantly watching the mechanical journals to glean facts that will be of value to them in their business, and many of them are ready to acknowledge that they have learned things from this source that have saved thousands of dollars to the roads they worked for. That valuable facts may be disseminated, the representatives of railroad journals must be granted the opportunity to collect them. The officers of many railroads are too one-sided in this matter. They are willing to take all, while they give nothing in return. In this respect the Chicago, Burlington & Quincy people are shining examples of the opposite policy, for they have a great deal to give, and part with it freely without making the recipients understand that the favors given are beyond repayment.

The Dangerous Freight Train.

The figures given in the report submitted by Messrs. Forney and Kirby at the Master Car-Builders' Convention, showing that the accidents most fatal to trainmen were that of falling from trains, has excited considerable surprise and comment. The murderous car coupler, and its treacherous ally the unguarded frog, have been popularly reputed by far the most sanguinary elements of railroad operating, although those who came in intimate contact with train service had too good reason to know that the death rate due to falling from trains was fearfully high. The figures in the report referred to were based on the annual reports of the railroad commissioners of Massachusetts, New York and Michigan, and show that while 13.1 per cent. of the persons killed on railroads lost their lives by car coupling, 27.4 per cent. were killed by falling from trains. This is probably a fair percentage for other states, for we find in the report of the Iowa railroad commissioners last year, that while 10 persons were killed coupling cars, 25 were sent to premature graves by falling from trains. In quoting these figures, we have no intention to underestimate the horrible slaughter that is constantly going on among the men who have to do the work of coupling cars, but rather to portray in its true aspect the danger of a brakeman's position. We have been for many years familiar with various hazardous occupations on land and sea; we have seen miners toiling in the bowels of the earth, subject at any moment to be crushed by falling masses of rock, or to be smothered by the no less deadly fire-damp; we have watched sailors furling sail in many a fierce gale, when sinews of iron were needed to enable men to cling to the swaying yards and ropes, but we never came in contact with an occupation that was so appalling in its dangers as that of applying hand brakes to an ice-covered train on a dark night, with the train swinging over an uneven track at a high rate of speed. Every winter there is a vast quantity of railroad property destroyed and many lives lost by collisions of freight trains at stations that are caused directly and indirectly by the imperfect means provided for stopping the trains. Here is a common case. A heavy freight train is approaching on a descending grade a station which ought to be neared slowly, in the expectation of finding a train on the main line. The engineer finds that the brakemen are not holding the train properly, but he also knows that the car roofs are glazed with ice, and with humane impulses he hesitates to urge the trainmen to run over the cars, he takes the chances of finding the main track clear, but when it is too late discovers it to be obstructed and an expensive collision ensues.

There was once a time when this helpless condition of an engineer running a freight train was a necessary evil, for the practicability of continuous power brakes for freight trains had not been demonstrated, but this necessity for compelling trainmen to run hazardous risks exists no longer. While inventors and railroad mechanical engineers were experimenting to find the most practicable brake for freight train service, and radical differences of opinion existed as to the practicability of different types, railroad managers had a good excuse for deciding to wait for more light before they began applying power brakes to their freight equipment, but the experiments carried out under the auspices of the Master Car-Builders Association have been so decisive, that there is now no longer an excuse for delay in effecting an improvement which is likely to be of great financial benefit to the roads carrying it out. The real question that awaited solution in the brake tests was, whether or not a machine brake operated by the momentum of the train or by friction appliances, and which could be applied at low first cost, was practicable? The experiments at Burlington answered very emphatically that it was not. This left the field confined to

air and vacuum brakes, and both systems are thoroughly efficient and reliable. Every man of ordinary judgment is now able to choose for himself in this narrowed field.

Every sentiment of humanity urges railroad managers to proceed earnestly with the work of applying power brakes to their freight trains, so that the army of young men who fall annually in this battle of life may be saved. We have always believed that equipping their freight cars with good power brakes would prove one of the most remunerative enterprises railroad companies could engage in, for the saving of property destroyed in wrecks caused by the weak hand brakes, and the acceleration of freight trains would save money enough to pay for an entire outfit of new brakes for cars and locomotives every few years. There is now a new and urgent worldly wisdom reason for applying power brakes. The impression has gone abroad that the question of a practicable freight train brake has gone beyond the region of experiment; and courts and juries will begin to decide that damages caused to life and property in accidents to freight trains that might have been prevented by the use of power brakes occurred through the neglect of the company to use proper safety appliances. When a brakeman falls from a train and gets killed, in a suit for damages the jury will be apt to hold that the company were responsible, and in all the hundreds of other suits that are brought annually against railroad companies for real and pretended damages caused by trains the pretense will be worked with court and jury that the failure of the company to provide efficient brakes contributed to the damage done. There are many good reasons why railroad companies should apply efficient brakes to their freight trains without more delay. It is better to do the work voluntarily than to be forced to it by legislation.

Another Champion of the American Locomotive.

We devote considerable space in this issue to the paper on The Construction of Canadian Locomotives, by Mr. Francis R. F. Brown, mechanical superintendent of the Canadian Pacific Railway, read at a recent meeting of the Institution of Mechanical Engineers in London. The Canadian Pacific locomotives are fair representatives of what has become known as the American type of locomotive. British engineers are noted for the blind unreasoning prejudice which they entertain for the American locomotive, and the reading of the paper elicited a warm discussion in which objections without grounds, dislike without reason, hatred without cause, formed the principal stock of argument. The leading assailant of the American type of locomotive was Mr. R. H. Burnett, an engineer who was at one time connected with a locomotive building establishment in England, and from thence went to New South Wales as a locomotive superintendent, where he was noted for his antipathy to the American built locomotives previously supplied to the road. His experience with American locomotives in Australia is supposed to have made Mr. Burnett a judge of the relative merits of English and American locomotives, and he has written voluminously in the British engineering journals on the subject, but always as a bitter enemy of the American engine. In the light of these facts the answer which Mr. Brown gives to Mr. Burnett's criticism will be read with great interest. It will be seen that the American locomotive has found in the mechanical superintendent of the Canadian Pacific Railway the most powerful defender and advocate it has ever had, for Mr. Brown has enjoyed long experience in maintaining English and American locomotives running side by side on the same road. His early mechanical training was English, and naturally his preferences at first were for that type of locomotive, but like nearly all fair-minded men experience with the two types of engines convinced him that the American style was better than the English.

An Improved Car Service System Needed.

This subject has been discussed year after year without any very marked progress in devising a practical remedy for existing evils. It is roughly estimated that there are 800,000 freight cars in the country in serviceable condition, and that the increase in their numbers during the last ten years has been at the rate of about 40,000 a year. This increase, as nearly as we can make it out from imperfect data, is fairly proportionate to the increase of tonnage for the same period. Yet it appears from statistics submitted to the committee on car service representing the great trunk lines, that the average mileage made by trunk line cars on foreign roads "does not exceed from 17 to 25 miles per day," which means, we suppose, an actual average of 21 miles a day—a reduction very nearly in inverse proportion to the increase in the number of cars. This also implies that at the rate of 10 miles an hour the cars are moving only one-twelfth part of the time. That this showing is substantially correct we have no doubt. But how is this state of things to be accounted for? It can not be due to the increased size of cars and weight of train loads. The engines now in use are heavier and more powerful, and the roadbeds and track much better adapted to a heavy traffic than they were years ago. There would seem to be no reason why the present increased tonnage should not be handled with greater facility and with comparatively fewer cars and side tracks than are now in use. The present car equipment ought to be enough and more than enough to meet the demand, if the cars that are away from home roads are properly handled and looked after.

There can be no question as to where the fault lies. It is in the absence of a well-devised business-like system for holding every road to a just accountability for the use they make of cars belonging to other roads. At present there is practically no check to the unnecessary detention of cars, and no incentive to give them fair usage while on foreign roads.

In the competition and rivalry inseparable from railroad operation, it is idle to expect that cars that are beyond the control of owners will always receive fair treatment in the absence of any inducement or responsibility. This state of things cannot last always, nor can any system be devised in the way of a reform that will be perfectly equitable. The present mileage basis for car service is about as bad as can be, and so long as it is adhered to without modification things will go on from bad to worse. A more objectionable plan as regards a check upon abuses, and placing the service upon a basis of equity, could hardly be devised. The per diem system pure and simple, even with its admitted defects, is evidently much better.

There is now a probability that a plan combining a mileage and per diem basis will ultimately be adopted and carried into effect. The special committee representing the five great trunk lines has submitted such a proposition to these lines, and, in order to test the plan before working out the details, have recommended that each of these lines keep its account of cars interchanged with the other trunk lines during the month of May, 1887, so as to show what would have been the result if the combined per diem and mileage systems had been in operation during that month. At the meeting of the Car Accountants' Association at Atlanta, Ga., in April last, the committee on the subject made a report, which was adopted by the association, recommending a similar combination of mileage and per diem charges, with specified details (see June N. C. & L. B.) to be acted upon at the next meeting of the association, June 19, 1888, unless a meeting shall be called by the president at an earlier date.

Petroleum-Burning Locomotives.

We have several times referred in these columns to the success achieved in Russia in using petroleum for fuel in locomotives, the honor and credit of the work being principally due to Mr. Thomas Urquhart, a Scotch engineer, who is locomotive superintendent of one of the most important railways in Russia. Some time ago the Pennsylvania Railroad Company concluded that a system of burning petroleum which was a success in Russia might be utilized to some extent on their road, so they sent an engineer to Russia to investigate the business. He returned lately, bringing a trial burner and drawings of the arrangement, and the device was applied in the shops at Altoona to engine No. 408. The engine is now at work using petroleum as fuel, and the performance so far has been quite satisfactory. Ordinary passenger trains have been run between Pittsburgh and Altoona, a distance of 117 miles, with about 450 gallons of petroleum. To make the same trip while burning coal, about three tons are generally used. So far as cost is concerned, there would be little or no saving effected by the use of petroleum, but the entire absence of smoke, sparks and dust would make the system highly advantageous for passenger service.

Colonel Hain, general manager of the Elevated Railroads of New York, has examined the system on trial by the Pennsylvania Railroad, and is so well pleased with it that he has made arrangements to have it adapted to one of the locomotives belonging to the Elevated road. Should it prove satisfactory there, there is a likelihood that all the engines on the Elevated roads will be burning petroleum very soon.

The essential features of Mr. Urquhart's scheme of burning petroleum, says the *Railroad Gazette*, consist in converting the oil itself into a finely divided state or spray, by means of a jet of steam or compressed air, and then burning this spray in the fire-box of the locomotive, in a fire-brick furnace constructed inside the fire-box. The burner or spray producer, if it may be so called, is essentially two tubes, one inside the other, the inner tube carrying the jet of steam or compressed air, and the outer tube carrying the oil. The oil tube is prolonged some distance beyond the steam tube, to allow the steam and oil to combine, and then the two together are projected from the end of the oil tube into the fire-box by the force of the steam. A single burner weighing, perhaps, 40 lbs., is sufficient for a locomotive of the largest size. The fire-brick furnace inside the fire-box is very simple in construction, and may be crudely compared to a bonnet, with the open end of the bonnet toward the injector or spray producer. The object of fire-brick is to receive the small particles of oil that escape combustion before they reach the fire-brick bonnet, and break them up so that they may be consumed. The bonnet furnishes, also, a combustion chamber for the proper mixing and burning of the oil and air; and serves another very important service, in that the fire-brick becomes intensely hot and radiates heat to all parts of the fire-box, and at the same time serves to reignite the oil after it has been shut off for a short period from any cause, as stopping at stations.

Sunday Labor on Railroads.

Mr. L. S. Coffin, one of the railroad commissioners of Iowa, sets forth in a letter to a railroad journal the many benefits which would accrue to thousands of officers and employés of the roads by a discontinuance of Sunday work. He also depicts very forcibly the pernicious and demoralizing effect of such work upon the young men and boys who are, from the nature of the service, deprived of the wholesome restraints and influence of home associations.

Nobody we imagine will deny the force of Mr. Coffin's reasoning in favor of reform. The moral truisms which constitute the staple of his argument are familiar to every body, and are as universally admitted as the proposition that two and two make four. What is wanted in order to bring about the reform so much desired by Mr. Coffin, as well as by railroad employés and a great many other people, is not a gush of sentimental moralizing, but a practicable plan by which the running of freight and passenger trains on Sunday may be greatly diminished if not entirely stopped. It must be admitted that the present conditions of railroad traffic, the relations of managers to stockholders and of the roads to each other and to their patrons, are very great obstacles to any such plan, and Mr. Coffin very considerately does not attempt to suggest one. Sunday respite from week-day toil, and railroad operation, are to a very great extent incompatible things. If Mr. Coffin has any doubt about it, he should go up in a balloon and take a bird's-eye look at things within a radius of fifty or a hundred miles around New York, or Boston or Chicago, on a pleasant midsummer Sunday. So far as the road managers are concerned, they are about as powerless to abate the evil complained of as a half dozen tug boats would be to keep a flood tide out of New York harbor. The only effective way that occurs to us for relieving railroad employés of all grades from Sunday labor is to persuade everybody to keep out of the cars on that particular day, and to ship no freight at any time that is not likely to reach its destination before "24 o'clock" on Saturday, except in cases of "absolute necessity," the Inter-state Commerce Commission to determine when such necessity actually exists "under substantially similar circumstances and conditions." This plan, we must admit, would not be altogether feasible; neither was Mrs. Partington's valorous attempt to push back the tide with her broom. The good lady meant well, but the Atlantic Ocean had its back up just then and proved too much for her.

Suburban Railroad Rolling Stock.

American master mechanics and designers of railway machinery have always been noted for their success in providing appliances suitable for working to the best advantage under special conditions. The American locomotive has been developed to suit the roads worked over, and to harmonize with other surroundings, and all other railroad machinery has been perfected very much under similar influences. Occasionally, however, the most direct road to a desired end is not taken, and the process of evolution that brings out the survival of the fittest is slow, hesitating, expensive and unsatisfactory. We believe that at present many officers in charge of railway machinery are blundering badly in the rolling stock they are providing for the suburban traffic, which is a growing element of business in connection with all cities. There is no kind of railroad transportation that pays better than well managed city and suburban passenger traffic, and railroad companies are foolish that do not give it encouragement. Where this is acknowledged to be true, it is a short sighted mistake to supply for the business cars that are too dilapidated for road traffic and locomotives so infirm that they can not be trusted to go ten miles from a repair shop. Inferior accommodation arouses the resentment of passengers and tends to make the service unpopular, besides it is not good policy to put fragile cars on trains that are constantly crowded, for when the inevitable collision happens the fatalities are proportionally numerous.

Good road engines and clean light day coaches will work suburban traffic fairly well while in its infancy, but so soon as the volume of business will justify the outlay, special locomotives and cars ought to be provided for this kind of service. The cars should be as light as possible, yet strong enough to resist severe shocks, and constructed with a view to be easily kept clean and cool in summer or warm in winter. The locomotives ought to be engines specially designed for this kind of business. The principal work done by the engine is forcing the train quickly into speed from a state of rest, and to do that kind of work to the best advantage ought to be the leading aim of the designer. To perform the work of starting the train quickly, ample cylinder power is necessary, and to prevent loss of effect by slipping there must be plenty of weight on the driving wheels to insure the required adhesion. A suburban traffic engine works very much under the same conditions as a switching engine, only the former is urged

more than the latter, and the considerations that lead all designers to place as much weight as possible on the drivers of a switching engine should lead to suburban engines receiving as much provision against the slipping of wheels as can be given without danger from excessive weight damaging the rails. In adopting the report on the Proportion of Locomotive Cylinders submitted at last convention, the Master Mechanics' Association went on record as favoring 4.5 as the co-efficient of adhesion for switching engines, and we think it ought to be 5 for suburban engines. That would make the weight on the drivers five times the power available for turning the wheels, the mean effective cylinder pressure being reckoned at .85 of the boiler pressure.

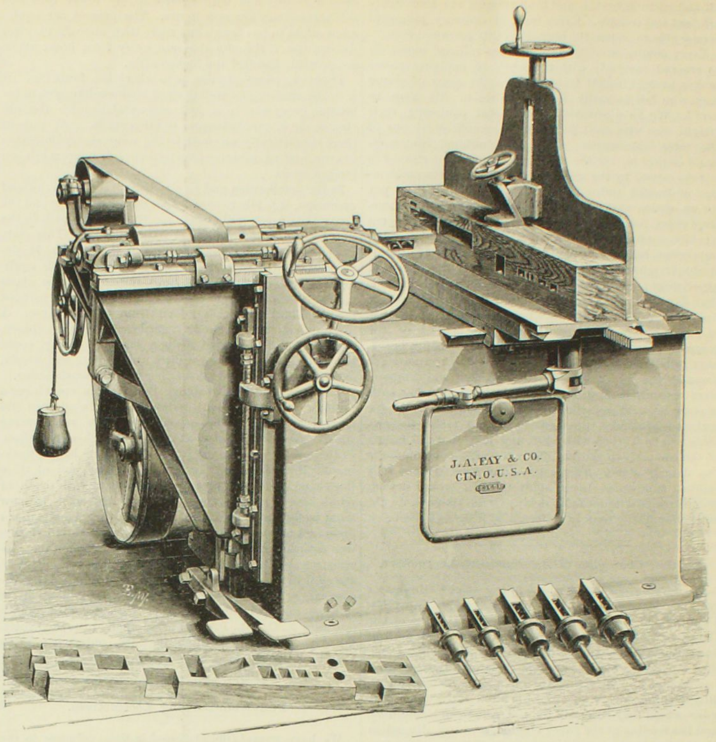
As the running speed of a suburban train is never much above thirty miles an hour, there is no necessity for the wheels being much more than four and a half feet diameter outside of the tires. The practice of attaching to locomotives operating suburban traffic a heavy tender loaded with coal and water sufficient for a long journey is wasting power dragging a useless burden. A small tender sufficient to carry coal and water for a short suburban journey is all the engine ought to be supplied with. If the coaling arrangements are such that the engine must take on enough coal to last several journeys, the interests of economy and good management demand that the coaling arrangements be changed to meet the requirements of business. When arrangements of this kind are carried out the proper type of engine for working suburban traffic economically is some modification of the Forney type, where the whole machine rests on one set of frames and the weight of the tender is utilized to give the driving wheels adhesion. There are several varieties of this style of engine working suburban traffic in different parts of the country, and no company that ever gives the engine a fair trial wants any thing else for that service. For an engine that will handle ten or twelve cars promptly there is nothing better than the Hudson locomotive, a type used exclusively by the Illinois Central for handling their heavy suburban traffic in Chicago. These engines have a four-wheel truck under the tank, two pairs of driving wheels connected in front of the fire-box, and a pony truck ahead of the smoke-box. The performance of the engines is excellent, and is much in advance of the work done by the debilitated road engines that do the greater part of the suburban traffic on other Chicago roads.

The metric system of measurement cranks are beginning to hold up their heads again about Boston, and they raised their voices with unusual strength in a late meeting of the Boston Society of Civil Engineers and succeeded in getting a paper on the subject and discussion thereon published in the *Journal of the Association of Engineering Societies*. As usual, they retailed the gigantic lie, that the metric system is used by 242 millions of people. The paper read by Mr. Coleman Sellers several years ago on the metric system so thoroughly punctured the wind-bag pretensions of the advocates of that system, that they lost their voices for a time, but they appear to be recovering again. They say that the system is making progress slowly in this country. To those who have much intercourse with the men who work by fine measurements, it is evident that the progress of the metric system is backward, and all sensible men have concluded that no measurement will ever be adopted by America and Britain that departs from the inch.

The formidable document put forth six weeks ago by the Inter-state Commission has been followed by a very perceptible lull in the long and short haul discussion. When simmered down to its simple elements, this immense cataract of words merely informs the railroad companies that in reference to the entanglements of the fourth section, they are at liberty to do as they please and take the chances. This the companies knew before. The commission is an advisory body and can not usurp judicial functions by forestalling the action of the courts. The legal validity of the law and the recondite meaning of its phrases can be brought to no final test except by the trial of issues as they arise by the judicial tribunals in the regular way.

The list published elsewhere of committees appointed by the president of the American Railway Master Mechanics Association to carry out the work of investigating mechanical questions during the current year, indicates that important subjects and plenty of them will come up for discussion at next convention. There are ten subjects selected for investigation besides the report on amendment of the constitution, and the latter ought to receive at least two or three hours attention from the Association. It looks as if an extra day would be needed to do the work of the next convention properly.

The Alabama Car Works, at Anniston, Ala., will increase their capacity to 25 cars a day. A large quantity of improved machinery has recently been added to the plant. The works are now in a condition to turn out cars of first-class construction, and are full of orders. They are now completing a contract for freight cars for the East Tennessee, Virginia & Georgia road.



AUTOMATIC HOLLOW CHISEL CAR MORTISING AND BORING MACHINE.

This is a powerful and compact machine, designed for freight car work. The principle upon which the mortises are made is that known as the hollow chisel, with an internal rotating auger. It has been in use for about thirty years. Its previous adaptation has been confined to lighter purposes, such as sash, doors, hubs, agricultural implement work, etc., but more recently to the heavy mortising required in freight car building. It is automatic in operation, lays out its own work by means of stops, and works with great rapidity upon any kind of timber hard or soft.

The chisel bar is carried in a heavy gateway, gibbed to the column with vertical adjustment to any desired height, to suit the mortise to be made; it has a horizontal traverse movement to and from the timber, the distance of which is regulated by stops. The chisel is made square in its cross sections, and set into a hollow collar at the front end of the gateway. An auger is arranged to revolve inside of the chisel, projecting slightly in advance of its cutting edge. It is constantly running, the chisel being passive, except when making a mortise. As the auger works slightly in advance of the chisel, the chips are carried by the twist of the auger into the chisel, escaping through openings in its side.

The chisel bar and auger has a slow, reciprocating motion, and will complete a hole the size of the chisel used. An inch chisel will cut an inch-square hole, consequently a mortise 1″ × 4″ would only require four strokes forward to complete it. It has a capacity to work mortises from ¾″ to 3″ square, and 5″ in depth, and any length desired. The boring spindle is driven by an idler pulley, direct from the countershaft.

The bed upon which the timber is placed to be mortised, is gibbed to a sliding frame, which allows it to be set to any position, with the chisel straight, or at an angle. It is adjustable to and from the chisel bar, to suit the size of material, the underside of which always remains at one height. Adjustments are provided for moving the carriage forward, for regulating the depth of the mortise, the position of the chisel from the face of the material, and the adjustment of the chisel bar, controlling the mortises to be made in the timber.

Two treadles are used upon the side of the machine; the pressure upon one carrying the chisel bar attachment forward, completing the mortise, while the other will instantly force it back when it is desired to withdraw it from the wood, without allowing it to cut its full depth. Provision is made, by stops, for regulating the length of the stroke, as well as the depth of the mortise.

When once set, and the machine started, it will make any number of mortises without change. Double mortises can be made without moving the position of the timber on the carriage, the adjustment of the chisel mandrel, at the desired point of the second mortise, being all that is necessary. The machine is furnished with ¾″, ⅞″, 1″, 1¼″, and 1½″ chisels and augers. The tight and loose pulleys are 10″ x 5½″, and should make 1,000 revolutions. Manufactured by J. A. Fay & Co., Cincinnati, O.

Some tests of the Cowell coupler have recently been made on the Union Pacific Railway, which are said to have fully established the durability, efficiency and practicability of the device.

Exhibits at the Conventions.

The following is a list of the noteworthy appliances exhibited at the recent conventions of the Master Mechanics' and Master Car-Builders' Associations held at St. Paul and Minneapolis:

American Brake Co., St. Louis, Mo.

Eames Vacuum Brake Co., Boston.—Blue prints of automatic vacuum train and driver brakes.

Stark Car Brake Co., Toledo, O.

McKeen Coupler Co., Easton, Pa.—A full size draw-head, showing operations of their device and method of applying the rod. Also, some patent buffers with springs behind them. Also, a malleable iron draw head, with latest improvements.

Cowell Platform & Coupling Co., Cleveland, O.—Their well known coupler and draw-head, and also one known as the Harrington, which was of the Janney type, swinging open, when unlocked, by gravity, and also locking with a gravity latch without springs. It will couple with the Janney.

Thurmond Car Coupling Co., Washington, D. C.—Vertical hook coupler, full size and model.

Dunham Manufaturing Co., Boston.—Side of a freight car, showing the Dunham storm-proof freight car door, also car door lock, hanger and shield.

Safety Car Heating & Lighting Co., New York.—Blue prints and plans of their system of heating cars with steam from locomotive, and two Pullman palace cars fitted up with the apparatus.

Sewall Safety Car Heating Co., Portland, Me.—Coupling, main valve and blue prints of the Sewall system of heating.

Martin Anti-Fire Car Heating Co., Dunkirk, N. Y.—Couplings and blue prints showing the system of heating.

Standard Car Heating & Ventilating Co., Pittsburgh.

St. Louis Car Roofing Co., St. Louis, Mo.—Their new Anchor iron car roof.

Drake & Wiers, Cleveland, O.—Winslow's patent asphalt car roofing.

National Car Roofing Co., Wheeling, W. Va.—H. C. Mechling, general agent, 18 Cliff street, New York.

Maguire Car Door Co., Indianapolis.—Side of car showing two forms of door.

Long & Harris, Pittsburgh, Pa.—Grain door for cars.

St. Louis Reclining Car Seat Co, St. Louis, Mo.—Two reversible reclining chairs with head and foot-rests.

Scarritt Furniture Co., St. Louis, Mo.—Four reclining chairs for drawing room cars.

M. N. Forney, 45 Broadway, New York.—Improved car seat.

Wakefield Rattan Co., Boston.—A plush car seat with curved steel slats under it; also, a rattan seat, both equipped with the Henry tilting frame.

Detroit Car Truck Co., Detroit, Mich.—A new equalizing car truck.

Hodges Brothers, of the Detroit Lubricator Co. and Detroit Car Truck Co., exhibited their sight-feed lubricator.

Towne End Door Fastening Co., Chicago.—Fastening for end doors of freight cars.

Hartford Woven Wire Mattress Co., Hartford, Conn.—A plush car seat, also one covered with leather, with woven wire seats under them. Also, a woven wire mat for cars.

W. F. Bailey, St. Paul, Minn.—Randolph's metallic compound for journal bearings.

Detroit Steel and Spring Works, Detroit, Mich.—Farrell's locomotive springs.

A. Whitney & Sons, Philadelphia.—Model of their new contracting chill for casting truer car wheels.

H. M. Boies, Scranton, Pa.—A Boies steel wheel for cars, tenders and locomotives.

National Hollow Brake Beam Co., Chicago.—A hollow brake beam made of 2-inch gas pipe.

Damascus Bronze Co., Pittsburgh, Pa.—Journal and side rod bearings, and samples of metal.

ELECTRIC ACCUMULATOR CO., New York.—An accumulator for lighting cars by electricity.
MISSISSIPPI GLASS CO., St. Louis.—A beautiful screen, showing the variety of their manufacturers in ondoyant deck lights for railway cars.
CONGDON BRAKE SHOE CO., Chicago.—The Ross-Meehan brake shoe, which applies equally to tread and flange.
FOX MACHINE CO., Grand Rapids, Mich.—Fox's universal trimmer.
JOHN BOOTH, Indianapolis.—Locomotive slide valve.
PHILLIPS, NIMICK & CO., Pittsburgh, Pa.—Boiler heads and flue holes.
TINKHAM & YOUNG, Boston.—McKenzie's raw-hide bearing dust guard.
WM. MCINTOSH, Huron, Dak.—Tool for moving cross-heads.
BLAINE CAR & MFG. CO., Dayton, O.—Model of side dump car.
GEO. W. MARBLE, Chicago.—Acme wrenches.
FEED-WATER HEATER CO., St. Johnsbury, Vt.—Model and blue print of feed-water apparatus.
M. M. BUCK & CO., St. Louis.—Improved locomotive headlight.
KALAMAZOO R. R. VELOCIPEDE CO., Kalamazoo, Mich.—Velocipede car and hand car with combination paper and wood wheels.
PITTSBURGH BOILER SCALE RESOLVENT CO., Pittsburgh, Pa.
E. M. ROBERTS, Ashland, Ky.—The "Big Sandy" sand driver.
HANCOCK INSPIRATOR CO., Boston, Mass.
THE MACK INJECTOR, Boston.
THE FREEDMAN INJECTOR, New York.
ASHTON VALVE CO., Boston.
CONSOLIDATED SAFETY VALVE CO., New York.
NOYES MANUFACTURING CO., Boston.
NATIONAL MACHINERY CO., Tiffin, O.
STONE'S anti-rattlers for window sashes.

Where are Our Electric Railroads?

In the course of an interesting article on Electric Street Railways in Europe, an English contemporary deplores in lengthened terms the red tape methods pursued in Great Britain in connection with the introduction of new enterprises, and to that restricting influence is attributed the slow progress made in introducing electric railways into the British Isles. The article says that in the United States electric tramways are successfully at work in many of the larger cities, and that preparations are going on in America to widely extend this method of traction. This looks as if we must go abroad to hear the news. We have for some time been searching large and small cities in America for an electric street railway in successful operation, but we have not yet been able to find one. There are numerous rumors to be heard of electric tramways running successfully, but when they are chased up they prove a veritable will o' the wisp. This season has been noted for a remarkable extension of street railways in the United States, and a large mileage of cable has been put down for operating street railways, and there is no difficulty in locating the cities where the "grip" is making headway, but we can not definitely locate any of the much talked of electric street railways.

Safety Appliances for Trainmen.

For some seven years previous to the last meeting of the Car-Builders' Association, no reports except nominal ones have been made by the committee on appliances for the safety of trainmen, although the committee has been continued from year to year and once or twice reconstructed. The subject being one of such vital importance, the apparent neglect of the committee for such a length of time to give any attention to it would seem to indicate a surprising indifference, or, that in its opinion every thing had already been done that the committee or the association could do to insure greater safety in the handling of freight trains. The records of the association show pretty clearly that the latter theory is the correct one, and this, if we leave out the coupler question, is confirmed by the report made by the committee at Minneapolis.

The last previous report (except the nominal ones referred to) was made at the Chicago meeting of the association in 1879. It was very full and exhaustive, and was accompanied with sundry recommendations which, with some slight modifications, were adopted by the association as standards. These recommendations related to the width of running-boards, position of brake staffs, steps and ladders, fastening of rachet wheel and pawl, etc. There being no "letter-ballot" at that time, this action of the association was regarded as final, and all the roads had to do in order to give their trainmen the accruing benefits was to adopt and adhere to what had been recommended. To what extent this has been done we will not undertake to say, but from the tenor of what is said at association and club meetings of railroad men, it does not appear that any particular heed has been given to these recommendations, but on the contrary, they seem to have been generally lost sight of and forgotten. In fact, the report made at Minneapolis is strongly confirmatory of this impression, which is also strengthened by the continuance of the committee for the purpose of recommending some standard improvements in the matter of steps, handles, railings, etc., next year. The report says that the committee is not prepared to recommend any improvements in these appliances, but that "the experience of members would enable them to point out defects and suggest improvements." Suppose their "experience" could do this. What would be the use, so long as the recommendations already made are practically disregarded and treated as a dead letter? Would new ones be likely to fare any better? Why continue to search and inquire into what has been already ascertained, discussed and disposed of, so far as the association can dispose of it?

The committee presents an array of figures showing the causes of railroad accidents in Massachusetts, New York and Michigan, and the percentages of fatalities and injuries from coupling cars upon which, presumably, non-automatic couplers were used, the percentages being 13.1 of the whole number killed, and 46.8 of the whole number injured. The obvious way to reduce the number of these casualties would seem to be the using of couplers that are automatic or self-acting. The report, however, gives no encouragement to such an inference, but raises the question whether there is any greater safety in couplers that are automatic in their action than in those of the non-automatic sort. "Many experienced railroad men," the report says, "are of the opinion that automatic couplers will not reduce the danger and the number of accidents from coupling cars." It hardly need be said that the general impression among laymen is quite the reverse of this, and if it turns out that the many experienced railroad men are right and the rest of the world wrong, the coupler question will have to be agitated over again from the very beginning and from a more scientific standpoint.

Jackson Bailey.

The technical press of America has lost one who was a credit to the profession, and suffering humanity has lost a warm friend in the death of Jackson Bailey, editor of the *American Machinist*, which happened at Brooklyn, July 7. Mr. Bailey was born at Schenectady in 1847, and when fifteen years of age enlisted in a regiment of New York infantry and served three years to the close of the war. He served under Sherman in the famous march to the sea, and was present at Missionary Ridge and several other battles. At the close of the war he returned to school and was afterwards engaged for some time in teaching school. His first newspaper connection was with a Pittsburgh trade paper. In 1877 he took part in establishing the *American Machinist*, and was for the remainder of his life its editor. He was a clear, incisive writer, and for a man with no systematic mechanical training, was remarkably happy in writing on mechanical subjects, and no one was quicker to perceive and acknowledge merit in other writers in this department. He was a genial, warm hearted man, pure of life, unassuming in his ways, but popular with associates; and no man ever had keener feelings than Jackson Bailey in sympathizing with suffering or sorrow. As his associates often remarked, Bailey's sympathies were always with the bottom dog in the fight.

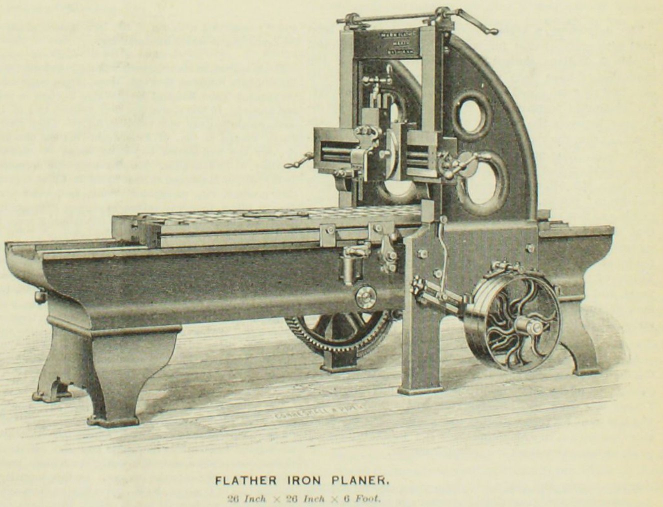
Mr. Bailey was first vice-president of the New York Press Club, a member of the American Society of Mechanical Engineers, which he helped to organize, and he belonged to several other technical and social societies. There are few men taken away who leave fewer enemies and more mourning friends.

The Chilled Wheel Manufacturers' Association.

A preliminary meeting of the makers of chilled cast iron wheels was held in New York in January last for the purpose of considering the subject of uniformity in sizes of wheels, methods of testing, manufacturing, etc. After considerable discussion, a committee was appointed on permanent organization with instructions to report at Minneapolis at the time of the meeting of the Car Builders' Association. In pursuance of this resolution, a number of the leading wheel makers met at the Hotel West, in Minneapolis, June 16. The committee reported a series of resolutions in favor of annual meetings, but without any permanent organization. The meeting, however, decided to form an association, and to that end a constitution was adopted, a copy of which is to be sent to all wheel makers. There are no by-laws. Any wheel maker can join the association by subscribing to the constitution. The following officers were elected: *President*, W. H. Barnum; *Vice-President*, J. H. Bass; *Secretary*, W. W. Lobdell; *Treasurer*, N. P. Bowler; *Executive Committee*, J. R. Whitney, Frank J. Hecker, W. W. Snow, N. S. Boughton, E. B. Tippetts. Future meetings are to be held at the call of the Board of Managers. A committee which had invited the Master Car-Builders' Association to appoint a committee of conference was continued, with instructions to wait on the Master Mechanics' Association and request the appointment of a similar committee.

The longest time that can elapse before the result of the vote on the standards sent to letter-ballot at the Minneapolis convention is five months from the time the vote to send them was taken. This limit would be reached about the middle of November. It is probable, however, that the vote on the coupler question, as well as on the other recommendations sent to letter-ballot, will be announced much earlier. The Secretary of the Association is required by the constitution to send out the blank ballots within three months after the convention, and to count the ballots received within sixty days after sending out the blanks.

In the proceedings of the Master Mechanics' Convention as published in our last issue (page 92), Mr. John Mackenzie, of the New York, Chicago & St. Louis road, in the discussion on cylinder oil, is reported as saying that he used the Detroit and Northern automatic lubricators. The word "Northern" is a misprint, and should read *Nathan*; the Nathan automatic lubricators being the ones referred to.



FLATHER IRON PLANER.

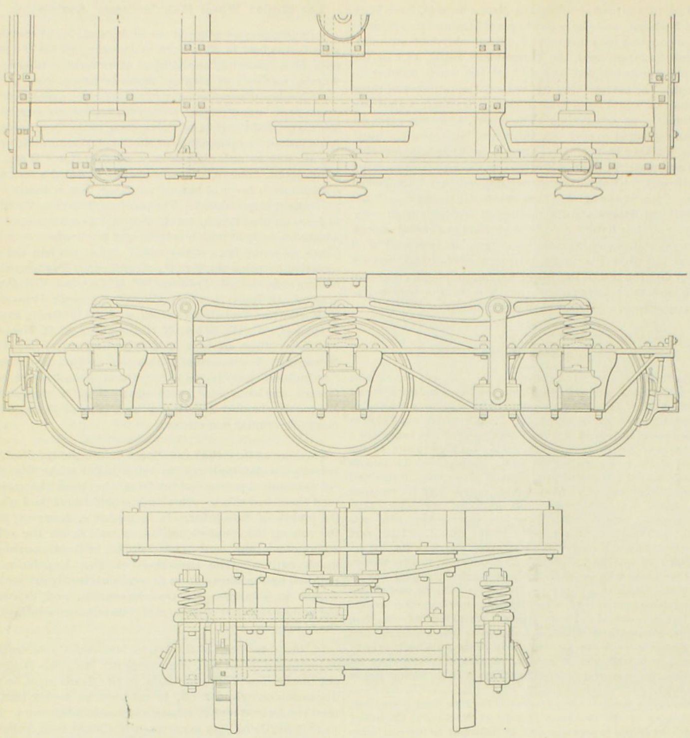
26 Inch × 26 Inch × 6 Foot.

THIS planer has been designed to meet the requirements of manufacturers who want a heavy, solid machine, which is also as handy as others of lighter weight, and is guaranteed to take as heavy cuts, without any tendency to jar or chatter when tool is at its greatest height, as any planer of this size made. The bed has great depth, and its length in proportion to length of table is greatly in excess of usual practice. It is thoroughly braced by box girders throughout its entire length, and is very heavy where the metal will do the most good. The uprights, extending well back, are also very heavy and well braced; they are scraped to fit sides and top of bed, keyed to under-side and fastened with large bolts, made to fit tight in reamed holes in sides of bed, making them as stiff as if cast solid with the bed. The table is very thick, with three bolt slots truly planed; the pin holes are drilled and reamed and are in perfect alignment with the table. The table receives backward and forward motion from open and cross belts, through a powerful train of cut gears and rack. These gears are mounted on shafts having very large diameters and extra long bearings. The belt shifter transfers but one belt at a time and is locked when in that position, so the belt can not work back on loose pulley, thereby giving the full power of belt to end of cut, causing the table to travel the same distance at every movement, making the tool cut very close to a line. It is entirely disconnected from feeding apparatus, and is arranged to throw out to clear the reversing dogs on the table, which can then be run back to examine work without changing position of dogs. The table is oiled by V-shaped wheels set in pockets in planer bed.

The feeding device is positive giving automatic feed in all directions. It is adjustable from 0 to ⅝ inch wide and takes no power except at moment of feeding. The cross rail is cored out in the form of a box girder. The down feed screw of crosshead has two nuts; provision is made for taking up all lost motion and preventing any tendency of the tool to drop.

All straight surfaces that are fitted are scraped to surface plates; all shafts and screws subject to wear or strains are made of best machinery steel; all wrenches drop forged and hardened, and all nuts and screws subject to bruising strains are case hardened. The weight of 6 foot planer is about 6,000 lbs. Speed of counter shaft about 340 revolutions a minute. Tight and loose pulleys 12 inch diameter, 4 inch face.

Manufactured by Mark Flather, Nashua, N. H. Hill, Clarke & Co., Boston, Mass., General Selling Agents.



THE FISH PATENT EQUALIZING CAR TRUCK.

The cuts show a style of car truck that has been used with great success for several years on the Grand Rapids & Indiana Railroad. Four-wheel trucks of the same design have been used under tenders and freight cars, and they are noted for their elasticity and durability. An admirable feature about the truck is that springs intervene between the weight of the truck and the axle boxes, so that the rigid blow imparted to the rail is necessarily light. The principle of putting in springs where they would cushion the severe blow of a fast running car has been too often neglected of late in the designing of freight car trucks. The truck illustrated looks like returning to first principles, but it is a move in a direction that must be traveled sooner or later. The most severe service that a car truck has to stand is running under a tender of an engine pulling fast trains on a rough track. Trucks of this design have stood that service for several years, and kept square and in good order. The truck is manufactured by the Detroit Car Truck Co., 11 Rowland street, Detroit.

At a meeting of the Executive Committee of the Master Car-Builders' Association, held immediately after the adjournment of the convention at Minneapolis, Mr. M. N. Forney was reappointed Secretary. Since then Mr. Forney has sent his resignation to the members of the Executive Committee, to take effect on the first of January next, unless a successor is appointed sooner.

We have received from the S. R. Niles Newspaper Advertising Agency of Boston a copy of the Maverick National Bank Manual, issued July 1, 1887. It is a volume of 200 pages, and contains a carefully compiled and well arranged mass of statistical information in regard to national, State and municipal indebtedness, savings banks secureties, banks and banking, coinage and currency, railroads, agriculture, shipping, telegraphs and a variety of other subjects. It has a table of contents and a full analytical index, and as a manual of information will be found very useful and convenient in business offices.

THE INDURATED FIBER CO., at Mechanicsville, N. Y., are manufacturing tubes or pipes from wood fiber by a patent process. These pipes are light, strong and cheaper than iron, and are made in lengths of about 5 feet. They are threaded with the standard iron pipe thread so as to be connected with iron pipe. The smallest size now made is 2½ inch, but the company will soon be able to furnish any size above 2 inch. The pipe is proof against corrosive acids and a non-conductor of electricity. The material has a tensile strength of about 1,100 pounds to the inch, and a 2½ inch pipe will stand from 80 to 100 pounds to the square inch. The company has arranged to furnish a large quantity of these tubes to the New York City Board of Electrical Control, and is negotiating with one of the largest natural gas companies for furnishing it with a like quantity.

The Wainwright Manufacturing Co., 65 and 67 Oliver street, Boston, with works at Medford, Mass., report large sales of their Corrugated Tube Exhaust Feed-Water Heaters in this country and abroad. In this connection they mention two of 1,000 h. p. each, which they are now building for the Lucy Furnace, Carnegie, Phipps & Co., of Pittsburgh, Pa.; and also one of large size for the well-known importing house of Strawbridge & Clothier, of Philadelphia. They have recently appointed Sen. V. de la Calle, of Matanzas, as their agent in Cuba for the sale of their product, viz., corrugated tubing, feed-water heaters, condensers, filters, four-way valves, expansion joints, radiators, and purifying plants for preventing the formation of scale in boilers

LONDON, BERRY & ORTON (Atlantic Works, Philadelphia), manufacturers of machinery for working wood, have issued their illustrated and descriptive catalogue for 1888. It contains 198 pages, with a full list of the standard machines made by the firm. Special attention is called to the original designs and improvements in timber planers, matching, mortising, tenoring, boring, gaining and sawing machinery of various weights and capacity and designed for all kinds of work. The volume contains full directions for ordering machines, numerous testimonials of the performance of band sawing machinery, and also a complete index.

The use of belts is comparatively little understood, although one of the oldest mechanical devices. Few persons, even among those who are constantly using them, can tell the best belt to use for a given location and frequently buy and use those that are entirely out of place, although costing much more probably than the one best adopted to the purpose. In this specialty, the Page Belting Co., of Concord, N. H., have made a thorough study of what to use, and how to use it, which they have published in pamphlet form, and will send free to all who desire a copy.

GOODALE & WATERS, of Philadelphia, have issued their illustrated and descriptive catalogue for 1887. It contains 114 pages of illustrations and descriptive details of wood-working machinery, including a number of new machines to which special attention is called; also an improved system of templets for duplicating parts and making repairs. All their machines are made interchangeable and are thoroughly tested before leaving the works.

THE EAMES VACUUM BRAKE CO. held its annual meeting in Watertown, N. Y., July 12, which resulted in the re-election of the present officers of the company. The company has orders on hand equal to its capacity for a year, which necessitates a further enlargement of the works, the present capacity of which will immediately be doubled.

The Lewis & Fowler Manufacturing Co., Brooklyn, N. Y., have issued an elaborately illustrated and descriptive catalogue of Street Railway Supplies, including every article required in the construction, equipment and maintenance of street railways.

The sales of the Pittsburgh Boiler Scale Resolvent Co. during the month of June amounted to more than 200 barrels of their compound. The condition of the sales is that the compound is not to be paid for unless it proves to be entirely satisfactory.

Mr. Edward Cliff has severed his connection with the Cliff & Righter Co., of Oswego, and will again represent Richard Vose and the National Car Spring Co., 13 Barclay street, New York.

The McMillan Car Works at Minaville, Mo., are to build a wheel foundry 85 × 221 feet. Its capacity will be 200 wheels per day.

The American Railway Equipment Company has been incorporated at Atlanta, Ga. The company proposes to buy, sell and manufacture railway cars, etc. The capital stock is $1,000,000.

We find that the brakes on cars of suburban trains on many railroads are operated by straight air. This is a dangerous practice and ought to be abandoned. The Bussey Bridge accident derived a serious part of its fatalities from the fact that straight air was used for the brakes of the train that went through the bridge, and every road employing this uncertain and dangerous method of braking is liable to have deadly collisions or derailments, made fatal through want of power to stop promptly at the time it is most needed. The excuse that railroad men make for operating city trains by a non-automatic brake is, that the elevated railroads of New York and Brooklyn are safely operated by straight vacuum brakes, and no accidents have ever happened. This is true, but the elevated roads are operated under different conditions from surface roads. Even these roads have had some very narrow escapes from serious accidents through failure of brakes, although there is nothing on the structure that will cause damage to the brakes, nothing to rupture a hose or break a pipe, and they do not have derailments, the kind of accidents that render a non-automatic brake worthless. It is only a question of waiting long enough for a road using a non-automatic brake to be overtaken by a bad accident that would have been prevented by the use of a proper brake

Our Directory.

We note the following changes since our last issue. Our readers will do us a great favor by giving us prompt notice of any changes that may come to their knowledge or of any errors that may be noticed in our list:

Boston & Maine.—G. Fred. Hurd has been appointed Purchasing Agent, vice Geo. J. Fisher, resigned. Mr. Hurd is also Purchasing Agent of the Eastern R. R.

Chicago, Milwaukee & St. Paul.—D. L. Bush has resigned the position of Superintendent of the Racine & Southwestern Division.

Chicago, St. Paul & Kansas City.—This road has been consolidated with the Minnesota & Northwestern.

Chicago, Santa Fe, & California.—C. W. Smith has been elected 1st Vice-President and General Manager.

Cincinnati, Jackson & Mackinaw.—F. B. Drake, late of the Missouri Pacific, has been appointed General Manager.

Cleveland, Columbus, Cincinnati & Indianapolis.—Edward Hill has been appointed Purchasing Agent, vice J. L. Yale resigned.

Elmira, Cortland & Northern.—Albert Allen, late of the Syracuse, Ontario & New York, has been appointed Superintendent.

Fitchburgh.—George J. Fisher, late of the Boston & Maine, has been appointed Purchasing Agent, vice F. S. Pratt, resigned.

Missouri Pacific.—A. W. Dickinson has been appointed General Superintendent of this road and the Missouri, Kansas & Texas, north of Texas, vice William Kerrigan, resigned. Joseph Herrin has been appointed General Superintendent of the St. Louis & Iron Mountain, the Memphis & Little Rock and the leased lines of the Missouri Pacific in Texas, comprising the main line and branches of the Missouri, Kansas & Texas in Texas, the International & Grand Northern and the Galveston, Houstou & Henderson. H. G. Clarke has been appointed Superintendent in place of F. B. Drake resigned.

Newport News & Mississippi Valley.—C. T. Dabney has been appointed Superintendent of the Newport News Division, vice J. W. Hopkins, resigned.

New York, Pennsylvania & Ohio.—Geo. W. West succeeds J. A. Cooper as Master Mechanic at Meadville, Pa., and W. Laverty succeeds Geo. W. West as Master Mechanic of the Mahoning Division.

Pittsburgh & Lake Erie.—John Newell, of the Lake Shore & Michigan Southern, has been appointed General Manager, and Elliott Holbrook General Superintendent.

Pittsburgh & Western.—Receiver Callery will perform the duties of General Manager in place of Thomas M. King, resigned.

Sonora.—A. C. Armstrong has been appointed Purchasing Agent.

Syracuse, Ontario & New York.—George H. Graves has been appointed Superintendent, vice Albert Allen, resigned.

Union Pacific.—J. O. Chapman, Master Mechanic of the Kansas Division, and R. McDougal Master Mechanic of the Colorado Divisions, have resigned their respective positions.

Wabash Western.—Charles M. Hays has been appointed General Manager, vice A. A. Talmage, deceased.

Employment.